METHOD FOR RECYCLING TREATMENT OF LIQUID CRYSTAL PANEL AND SYSTEM FOR RECYCLING TREATMENT

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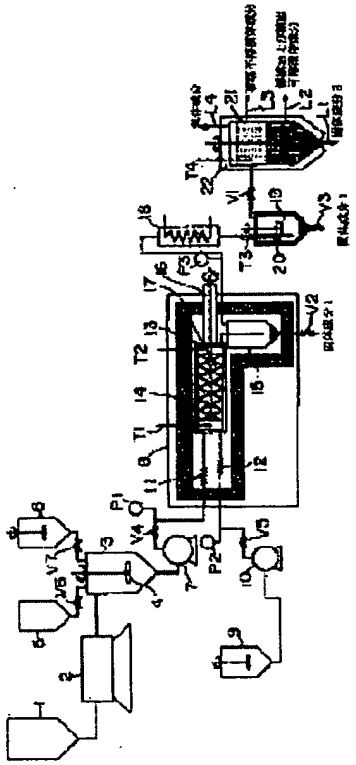
Abstract of **JP2001235718**

PROBLEM TO BE SOLVED: To provide a method of recycling a liquid crystal panel and a system for the recycling process by which a liquid crystal panel can be efficiently processed, the effective components in the liquid crystal panel can be recovered at high yield, and discharge of harmful substances accompanied by the process can be decreased. SOLUTION: The liquid crystal panel to be processed is sent to or put into a supercritical reaction chamber 13 in a supercritical reactor 8 without separating plastics or metals. The liquid crystal panel is decomposed and dissolved by a supercritical fluid in the supercritical reaction chamber 13. The decomposed and dissolved product in the supercritical fluid is sent to a solid trapping chamber 15 where a solid component 1 in the liquid crystal panel is recovered. Further the temperature of the product is decreased by a cooling device 18 and the product is sent to a solid trapping tank 19 where a crystallized solid component 2 in the liquid crystal panel is recovered. Then the pressure of the product is reduced to the atmospheric pressure through a high-pressure controlling valve V1 and the product is sent to a separation tank 21, where a solid component 3 in the liquid crystal panel is crystallized while the liquid crystal and the synthetic resin material in the liquid crystal panel are separated into phases of a solvent, solvent-soluble liquid component, solvent-insoluble liquid component and gas component and each component is recovered as a material for recycling.



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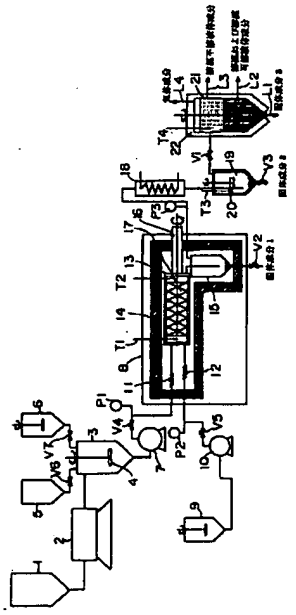
(54)【発明の名称】　液晶パネルのリサイクル処理方法およびリサイクル処理システム

(57)【要約】
【課題】　液晶パネルの処理を効率よく行い，液晶パネル内の有用成分を高収率で回収でき，処理に伴う有害物質の排出を低減するリサイクル処理方法およびリサイクル処理システムを提供する。
【解決手段】　処理すべき液晶パネルをプラスチックや金属に分別することなく超臨界反応器(8) 内の超臨界反応室(13)に送り込み，あるいは仕込む。この超臨界反応室(13)内において超臨界流体により上記液晶パネルを分解，溶解する。超臨界流体に分解，溶解した生成物は，固体捕集室(15)に送られ液晶パネル中の固体成分１が回収される。さらに冷却器(18)により上記生成物の温度を下げて固体捕集槽(19)に送り，析出した液晶パネル中の固体成分２を回収する。その後，高圧調圧弁(v1)を通して生成物の圧力を大気圧まで減圧し分離槽(21)に送り，液晶パネル中の固体成分３として析出し，かつ液晶パネル中の液晶及び合成樹脂材料を溶媒および溶媒可溶液体成分，溶媒不溶液体成分，気体成分として相分離し，それぞれリサイクルに供することのできるものとして回収する。



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【特許請求の範囲】

【請求項１】　液晶パネルのリサイクル処理方法であって，超臨界場を作成できる超臨界反応器内に処理すべき液晶パネルと超臨界溶媒を供給し，該超臨界反応器内を加熱加圧して上記超臨界溶媒を超臨界流体とし，該超臨界流体により上記液晶パネルを分解，溶解し，その生成物を冷却，減圧することにより液晶パネル中の金属成分等を析出し，かつ該液晶パネル中の液晶及び合成樹脂材料を低分子化合物等として分離し，リサイクルが可能な物質を得ることを特徴とする液晶パネルのリサイクル処理方法。

【請求項２】　上記液晶パネルは粉砕され，超臨界溶媒に混合，分散され，臨界圧力に加圧されて上記超臨界反応器内に供給される請求項１に記載の液晶パネルのリサイクル処理方法。

【請求項３】　上記液晶パネルは，超臨界反応器内に直接供給され，上記超臨界溶媒は臨界圧力に加圧されて上記超臨界反応器に供給される請求項１に記載の液晶パネルのリサイクル処理方法。

【請求項４】　上記処理すべき液晶パネルは，回路基盤を含み，若しくは液晶パネルから分離した液晶であり，上記超臨界溶媒は臨界圧力に加圧されて上記超臨界反応器に供給される請求項１に記載の液晶パネルのリサイクル処理方法。

【請求項５】　超臨界溶媒は水である請求項１ないし請求項４のいずれかに記載の液晶パネルのリサイクル処理方法。

【請求項６】　上記液晶パネルから回収される物質は，インジウムである請求項１に記載の液晶パネルのリサイクル処理方法。

【請求項７】　上記超臨界流体に分解，溶解しない成分を超臨界反応器内で回収し，上記生成物を臨界温度以下に冷却して金属成分等を回収し，その後大気圧に減圧して気体成分，溶媒不溶液体成分，溶媒および溶媒可溶液体成分，固体成分を分離回収するようにした請求項１ないし６のいずれかに記載の液晶パネルのリサイクル処理方法。

【請求項８】　液晶パネルのリサイクル処理システムであって，超臨界場を作成できる超臨界反応器内に設けられ処理すべき液晶パネルと超臨界溶媒を収納する超臨界反応室と，該超臨界溶媒を超臨界流体にするよう該超臨界溶媒を臨界圧力に加圧する高圧ポンプ及び臨界温度に加温するヒータと，上記超臨界反応室で超臨界流体により液晶パネルは分解，溶解され，その生成物を冷却する冷却器と，臨界温度以下で析出した液晶パネル中の金属成分等を回収する固体捕集槽と，臨界圧力以下に生成物を減圧して液晶パネル中の液晶及び合成樹脂材料を低分子化合物等として回収する分離槽を具備することを特徴とする液晶パネルのリサイクル処理システム。

【請求項９】　上記液晶パネルを粉砕する粉砕機と，超臨界溶媒を粉砕された液晶パネルに混合，分散してスラリーとするスラリー貯槽と，このスラリーを臨界圧力に加圧して上記超臨界反応器に供給する高圧スラリーポンプを有する請求項８に記載の液晶パネルのリサイクル処理システム。

【請求項１０】　上記超臨界反応器と超臨界反応室は上記液晶パネルを直接供給できるよう開閉可能に形成され，超臨界溶媒を臨界圧力に加圧して上記超臨界反応器に供給する高圧流体ポンプを有する請求項８に記載の液晶パネルのリサイクル処理システム。

【請求項１１】　超臨界溶媒を臨界圧力に加圧して上記超臨界反応器に供給する高圧流体ポンプをさらに有する請求項９に記載の液晶パネルのリサイクル処理システム。

【請求項１２】上記超臨界反応器内には，上記超臨界流体に分解，溶解しない金属成分，無機物質等を回収する固体捕集室が設けられている請求項８ないし１１のいずれかに記載の液晶パネルのリサイクル処理システム。

【請求項１３】上記超臨界反応器内には生成物を撹拌掻出するための撹拌掻出翼が設けられている請求項８に記載の液晶パネルのリサイクル処理システム。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は液晶パネルを有害物質の排出を低減した状態で処理し，液晶パネル内の有用金属，ガラスを回収するとともに，液晶および樹脂を無害な低分子化合物に分解し，回収するリサイクル処理方法およびリサイクル処理システムに関するものである。

【０００２】液晶ディスプレーは現在，ノート型パソコン，ビデオカメラ，携帯電話，電卓，時計などの表示デバイスとして汎用されている。さらに近年では屋内外用大型液晶ディスプレーや液晶テレビ等の開発が進み，その用途，生産量は極めて大きくなっている。これらの液晶ディスプレーは，液晶ディスプレー自体の故障の他，液晶ディスプレーが接続されている機器の故障や寿命あるいは型遅れによっても廃棄され，年間膨大な量が廃棄されている現状にある。

【０００３】図４には，液晶ディスプレーの構成の一例としてパソコン用ＴＦＴ（Thin Film Transistor）方式カラー液晶ディスプレーの概略が示されている。図中のプラスチックシャーシ(31)，ランプ(32)，ランプ反射板(33)，ランプカバー(34)，拡散シート(36),(39)，プリズムシート(37),(38)，導光板(40)，反射シート(41)は液晶ディスプレーを解体，分別することで部品として再使用，あるいは資源として再利用することが可能であるが，液晶ディスプレーの本体を成す液晶パネル(35)やその内部に封入されている液晶，回路基盤(42)等の処理法は確立されていない状況にある。

【０００４】図５には現在汎用されているＴＦＴ方式のカラー液晶パネルの一例の断面概略図が示されている。

液晶パネル(35)は，カラーフィルタ基盤板ガラス(43)，ＴＦＴ基盤板ガラス(44)をエポキシ系のシール樹脂(45)で接着し，その間隙に液晶(46)およびアクリル系樹脂製のスペーサー(47)を封入して構成されている。カラーフィルタ基盤板ガラス(43)の片側面にはアクリル系樹脂製の偏光板(48)が接着されており，液晶と接する面には赤，青，緑，黒の色材より構成されるカラーフィルタ(49)，液晶を配向させる配向膜を含む透明電極(50)が設置されている。また，ＴＦＴ基盤板ガラス(44)の片側面にも同様にアクリル系樹脂製の偏光板(51)が接着されており，液晶に接する面には配向膜及びＴＦＴ(52)を含む透明電極(53)が設置されている。

【０００５】上記透明電極（ＩＴＯ）(50)，(53)は，一般にアクリル系の導電性樹脂中にＴＦＴ(52)を構成するよう作製されており，内部にはインジウムやモリブデン，タンタル等のレアメタル，貴金属等の高付加価値有用金属やチタン，アルミニウム，スズ，タングステン，マンガン，ゲルマニウム等の金属，さらにはそのまま廃棄された場合に環境に対して有害となるクロム，ヒ素，鉛，カドミウム，ガリウム等の金属が存在している。また，上記液晶としては，大別してネマティック液晶，スメクティック液晶，強誘電性液晶が用いられるが，それらの物質は全て直鎖アルキル基やシアノ基で修飾されたベンゼン環およびシクロヘキサン環が－ＣＯＯ－，－ＣＨ＝ＣＨ－，－CH_2 CH_2 －の結合で結ばれた直鎖状の基本構造を有しており一部の液晶については毒性を有することが知られている。また，一般に液晶ディスプレーは複数の液晶物質を混合して用いている。

【０００６】液晶パネルのリサイクル処理においては，透明電極，ＴＦＴに含まれるレアメタル，貴金属，特にインジウム等の高付加価値有用金属成分を再利用できる状態で回収すること。液晶を廃棄，あるいは再利用できる無害な低分子化合物に分解すること。偏光板，シール樹脂，スペーサー，透明電極等の樹脂成分を廃棄，あるいは再利用できる無害な低分子化合物に分解すること。カラーフィルタ基盤板ガラス，ＴＦＴ基盤板ガラス等のガラスを再利用できる板ガラスの状態あるいはガラスカレットの状態で回収することが要求されるが，下記する従来の液晶パネルの処理法ではこれらの事項が十分満たされているとはいえない。

【０００７】液晶パネルは，これまで埋め立て，あるいは焼却により処理されてきた。液晶パネルを埋め立てにより処理する方法では，液晶パネル内に存在する有用成分，すなわちレアメタル，貴金属や樹脂成分を回収することなく廃棄するため，資源再利用，有効利用の観点から問題となる。埋め立てられた液晶パネルから流出する液晶や重金属化合物による土壌汚染も大きな問題である。液晶パネルを耐腐食性の容器に入れ，鉱山の廃坑に埋め立てる方法も採られているが，液晶パネルの根本的な処理とはいえない。

【０００８】液晶パネルを焼却し，処理する方法では，液晶ディスプレー内に存在する有用成分を十分回収することなく燃焼するため，資源再利用，有効利用の観点から問題となる他，燃焼時にダイオキシンを含む有害物質を発生することも問題である。

【０００９】液晶パネルを１０００℃以上の高温条件の炉内で製鋼煙灰，石炭等と混合して燃焼することで，ダイオキシン等の有害物質の生成を抑え，酸化亜鉛，金属溶融塊，スラグを回収する方法も提案されているが，処理装置が極めて大掛かりとなることや石炭を燃焼燃料に用いるため省エネルギーの観点や，空気中の二酸化炭素濃度を増大させる点が問題となる。

【００１０】液晶パネルを粉砕して粘土と特殊な配合で混合し，９００℃程度の温度で焼成することによりタイルや建設骨材を製造する方法もあるが，同法では液晶パネルを粉砕する前に，予め液晶パネルのカラーフィルタ基盤板ガラスとＴＦＴ基盤板ガラスを剥離し分離させ，さらに各々の基盤板ガラス上の偏光板を剥離することが必要であり，そのための特殊な装置が要求され，液晶パネルを大量に処理する方法としては問題がある。また，剥離した偏光板や液晶の処理は考慮されていない点も問題である。

【００１１】

【発明が解決しようとする課題】本発明の解決課題は液晶パネルを有害物質の排出を低減した状態で処理し，液晶パネル内の有用金属，ガラスを回収するとともに，液晶および樹脂を無害な低分子化合物に分解し，回収できるようにした液晶パネルのリサイクル処理方法およびリサイクル処理システムを提供することにある。

【００１２】

【課題を解決するための手段】本発明によれば，金属や金属酸化物に対する溶解度が大きく，液晶や樹脂等の有機物の分解反応に対して極めて反応性に富み，有機物に対する溶解度も大きく，かつ圧力や温度を変化させることにより，その反応性や溶解度を連続的に速やかに変えることができる超臨界流体の性質を利用して液晶パネルを処理する方法及びシステムが提供される。すなわち，超臨界状態を作成できる超臨界反応器において液晶パネル内の有用金属成分等を溶解，回収し，また液晶パネル内の液晶を無害な低分子化合物に分解し，さらには液晶パネル内の樹脂成分を各々の樹脂を構成する低分子有機化合物等に分解，回収することを特徴とする超臨界流体を用いた液晶パネルのリサイクル処理方法およびリサイクル処理システムが提供され，上記課題が解決される。

【００１３】なお，本発明において，超臨界溶媒とは超臨界状態を作るための溶媒を意味し，また，超臨界状態，超臨界流体とは図６に示すように温度－圧力相図上で臨界温度，臨界圧力を越えたいわゆる超臨界状態，超臨界流体の他，そのような臨界温度，臨界圧力をわずかに下回るような状態であっても反応性および物質に対す

る溶解度のうえで超臨界状態，超臨界流体と同様の能力を有する亜臨界状態，亜臨界流体を含むものとする。

【００１４】超臨界流体の性質について水を例に説明する。一般に物質の溶媒への溶解速度や溶解度は温度に対して増加する。そのため室温の溶媒に比較して，高温の状態にある超臨界状態においては，物質の溶媒への溶解速度や溶解度は常温の溶媒に比較して大きくなる。図７は，圧力と水の誘電率の関係をいくつかの温度について示している。ここで誘電率とは，物質のもつ極性を示す指標であり，圧力を大きくし超臨界状態とすることで水の極性が大きくなることが判る。このように誘電率が大きく，すなわち極性が大きい超臨界流体中では，金属や金属酸化物と有機化合物の両者について物質の溶解速度や溶解度が大きくなる。

【００１５】図８は，圧力と水のイオン積の関係をいくつかの温度について示している。ここで水のイオン積とは，水中の水素イオン濃度と水酸化物イオン濃度の積であり，圧力を大きくし超臨界状態とすることで，水のイオン積は大きくなる。このようにイオン積が大きい超臨界流体中では，水素イオンが酸として働き，水酸化物イオンがアルカリとして働くため金属や金属酸化物の溶解速度，溶解度が大きくなる。

【００１６】また，一般に各種の反応速度は温度に対して指数的に増加する。そのため室温の溶媒に比較して高温の状態にある超臨界状態においては，各種の反応が常温の場合に比較して高速で起こる。さらに図７に示したように圧力を大きくし超臨界状態とすることで水の極性が大きくなり，このような超臨界流体中では樹脂や有機物の加水分解反応等，イオン的反応の反応速度が大きくなる。また図８のように圧力を大きくし超臨界状態とすることで，水のイオン積は大きくなり，このような超臨界流体中においては，イオン的反応の反応速度が大きくなる他，水素イオンが酸として働き，水酸化物イオンがアルカリとして働くため酸触媒反応とアルカリ触媒反応の両者の反応速度が大きくなる。

【００１７】上記したような特徴を有する超臨界流体中に液晶パネルが存在した場合には，透明電極やＴＦＴに含まれるインジウム等の高付加価値有用金属を含む金属成分の大半は超臨界流体に溶解することになる。また液晶パネル内の液晶は，その分子内の－ＣＯＯ－，－ＣＨ＝ＣＨ－，－CH_2 CH_2－等の結合やベンゼン環，シクロヘキサン環を修飾する直鎖アルキル基やシアノ基が加水分解，および熱分解等の反応により開裂し，ベンゼン環あるいはシクロヘキサン環を骨格とする低分子有機化合物に，さらにはベンゼン環あるいはシクロヘキサン環自体も迅速に分解され，超臨界流体に溶解される。液晶パネル内の偏光板，樹脂シール，スペーサーおよび透明電極等のアクリル系およびエポキシ系樹脂は，超臨界流体中で全て樹脂を構成する低分子化合物に迅速に分解し，超臨界流体中に溶解することとなる。カラーフィルタ基盤板ガラス，ＴＦＴ基盤板ガラス，カラーフィルタに含まれる色材等の無機物など超臨界流体による分解，溶解が困難成分は金属成分，樹脂成分と分離し固体として超臨界流体中に残ることになる。さらに溶解した超臨界流体に溶解した低分子有機化合物や金属は温度を下げるあるいは圧力を小さくすることで速やかに超臨界流体から分離あるいは析出させることができる。

【００１８】

【発明の実施の形態】図１は，本発明の液晶パネルのリサイクル処理システムの一実施例を示す説明図である。同図において，処理すべき液晶パネルを収納する被処理物貯槽(1) は，液晶パネルを粉砕する粉砕機(2) に連結されている。該粉砕機(2) は粉砕された液晶パネルと超臨界溶媒および処理に必要となる触媒，酸化剤等の薬剤を混合しスラリーとして収納するためのスラリー貯槽(3) に連結されている。なお該粉砕機(2) としては破断機に相当する粗粉砕機や予め液晶パネルを液体窒素等で冷却・凍結させて粉砕を高効率で行う粉砕機等，既存の装置を用いることができる。

【００１９】上記スラリー貯槽(3) には，超臨界溶媒を収納する超臨界溶媒貯槽(5) がバルブ(v6)を介して連結され，処理に必要となる触媒，酸化剤等の薬剤を収納する触媒，薬剤等貯槽(6) がバルブ(v7)を介して連結されている。また，該スラリー貯槽(3) には，処理すべき液晶パネルと超臨界溶媒，処理に必要となる触媒，酸化剤等の薬剤を混合，分散しスラリーに調製するためのスラリー貯槽撹拌翼(4) が設置されている。上記スラリー貯槽(3) は，超臨界状態を作成し超臨界流体による処理を行う超臨界反応器(8) に連絡する高圧スラリーポンプ(7) に連結されている。

【００２０】上記超臨界反応器(8) には，超臨界溶媒や処理に必要となる触媒，酸化剤等の薬剤を収納する溶媒，触媒，薬剤等貯槽(9) に連絡する高圧ポンプ(10)が高圧バルブ(v5)を介して連結されている。また，該超臨界反応器(8) の吐出口には，生成物および超臨界流体の温度を下げるための冷却器(18)を介して固体捕集槽(19) が連結されている。なお該超臨界反応器(8) の入口部，出口部には該超臨界反応器(8) 内の圧力を観測するための圧力計(P1)，(P2)，(P3)が設置されている。

【００２１】上記超臨界反応器(8) としては，図１に示した構成の他，後記するように図２(a)，(b) および図３(a)，(b)，(c) に示す構成を用いることができる。図１に示した超臨界反応器(8) には，該超臨界反応器(8) 内を臨界温度以上に加熱するための加熱ヒータ(14) が設置されている。また，該超臨界反応器(8) 内には超臨界流体による処理を行う超臨界反応室(13)，該超臨界反応室(13)と上記高圧スラリーポンプ(7) を高圧バルブ(v4)を介して連絡し，液晶パネルを含むスラリーを臨界温度以上に加熱するスラリー予備加熱器(11)，該超臨界反応室(13)と上記高圧ポンプ(10)を連絡し溶媒や液晶パ

ネルの処理に必要となる触媒，酸化剤等の薬剤を臨界温度以上に加熱する溶媒，触媒，薬剤等予備加熱器(12)，処理により生成する生成物中の固体成分１を捕集する固体捕集室(15)が設置されている。

【００２２】上記超臨界反応室(13)には，高温高圧撹拌軸シール(16)を介して駆動される超臨界反応室撹拌掻出翼(17)等の生成物を的確に掻き出す機構を設置することもできる。また該超臨界反応室(13)の入口部，出口部には該超臨界反応室(13)内の温度を観測する温度計(T1)，(T2)が設置されている。なお上記高温高圧用撹拌軸シール(16)としては，メカニカルシールの他，交流外部磁界を用いたもの，あるいは永久磁石によってモータの駆動力を撹拌翼に伝達するもの等，ノンシール型のものを用いてもよい。

【００２３】また，上記固体捕集室(15)は，上記超臨界反応器(8) の外に設置した上記冷却器(18)に連結しており，該固体捕集室(15)の排出口には固体回収用高温高圧バルブ(v2)が設置されている。該固体捕集室(15)としては図１に示した実施例では粒子沈降槽形式のものを用いているが遠心力場を利用し、固体のみを上記固体捕集室(15)の底部に捕集するサイクロン形式のもの等を使用することもできる。

【００２４】図２(a) に示す超臨界反応器(8) は，図１に示した超臨界反応器(8) を縦長の槽型あるいは塔型の形態に構成し，設置面積を小さくしたものである。該超臨界反応器(8) には，スラリー予備加熱器(11)，溶媒，触媒，薬剤等予備加熱器(12)，超臨界反応室(13)，加熱ヒータ(14)および固体捕集室(15)等が具備されており，上記スラリーは超臨界臨界反応器(8) の上方より該超臨界反応器(8) に入り，下方より冷却器(18)に連絡する固体捕集室(15)に送液されるように構成されている。なお，上記超臨界反応器(8) は必ずしも垂直に構成，設置される必要はなく，任意の角度で設置してもよい。

【００２５】また，図２(b) に示す超臨界反応器(8) は，超臨界反応室(13)の底部に仕切メッシュ(23)を設けて内部に固体捕集室(15)を区画形成し，一体型の構造としたものである。該超臨界反応器(8) にはスラリー予備加熱器(11)，溶媒，触媒，薬剤等予備加熱器(12)，超臨界反応室(13)および加熱ヒータ(14)等が具備されており，上記スラリーは超臨界反応室(13)と固体捕集室(15)を区切る上記仕切メッシュ(23)の上方より該超臨界反応室(13)に入り，超臨界反応室(13)の上方から冷却器(18)に送液されるように構成されている。なお，上記超臨界反応器(8) は必ずしも垂直に構成，設置される必要はなく，任意の角度で設置してもよい。

【００２６】さらにまた，超臨界反応器(8) としては図３(a)，(b)，(c) に示すように，図１および図２(a)，(b) に示した上記超臨界反応器(8) の加熱ヒータ(14)の一部および超臨界反応室(13)の一部に，処理すべき液晶パネルを直接仕込むため開閉可能な加熱ヒータ蓋部(24)および超臨界反応室蓋部(25)を形成したものを使用することもできる。

【００２７】上記冷却器(18)に連結されている上記固体捕集槽(19) には，該固体捕集槽(19)内の温度を観測するための温度計(T3)，該固体捕集槽(19)内を調温するための調温ジャケット(20)が設置されており，排出口には冷却器(18)および調温ジャケット(20)により温度が低下したことよって超臨界溶媒から析出した固体成分２を回収するための固体回収用高圧バルブ(v3)が設置されている。該固体捕集槽(19)は，処理によって生成した生成物を分離，回収するための分離槽(21)に高圧調圧弁(v1)を介して連結している。なお上記固体捕集槽(19)としては図１に示した粒子沈降槽形式のものや遠心力場を利用し、固体のみを上記固体捕集槽(19)の底部に捕集するサイクロン形式のもの，あるいはさらにサイクロン形式のものに撹拌翼を設置し，遠心力による固体と液体の分離性能の向上させた形式のもの等が使用できる。

【００２８】上記分離槽(21)には，該分離槽(21)内の温度を観測する温度計(T4)，該分離槽(21)内を調温する調温ジャケット(22)が設置されている。また，高圧調圧弁(v1)により圧力が低下することによって分離した固体成分３，溶媒および溶媒可溶液体成分，溶媒不溶液体成分，気体成分を各々回収するための固体成分回収ライン(L1)，溶媒および溶媒可溶液体成分回収ライン(L2)，溶媒不溶液体成分回収ライン(L3)，気体成分回収ライン(L4)が連結している。

【００２９】而して上記システムを用いて液晶パネルを処理するには，処理すべき液晶パネルを被処理物貯槽(1) に仕込み，粉砕機(2) で粉砕しスラリー貯槽(3) においてスラリーに調整した後，超臨界反応器(8) に供給する第１の方法と，処理すべき液晶パネルを直接，超臨界反応器(8) 内の超臨界反応室(13)に仕込む第２の方法を採ることができる。

【００３０】ここで処理すべき液晶パネルとは，図４に示した液晶パネル(35)，あるいは該液晶パネルからの分離が困難な回路基盤(42)を含んだもの，あるいは別途手法で液晶パネル(35)から分離された液晶(46)であってもよい。

【００３１】以下に第１の方法について示す。処理すべき液晶パネルは被処理物貯槽(1) から粉砕機(2) に送られ，該粉砕機(2) により所定の大きさすなわち，後記する超臨界流体により容易に分解，溶解する程度の粒径まで粉砕される。

【００３２】粉砕された液晶パネルは，スラリー貯槽(3) に送られる。該スラリー貯槽(3)では該スラリー貯槽(3) に設置されたスラリー貯槽撹拌翼(4) により，超臨界溶媒貯槽(5) から供給される超臨界溶媒と液晶パネルを混合，分散しスラリーに調製される。この場合，特に望まれるときには，処理に必要となる触媒，酸化剤等の薬剤を触媒，薬剤等貯槽(6) よりラリー貯槽(3) に供

給し，スラリーを調製してもよい。また，液晶パネルから分離された液晶そのものを処理する場合には，液晶を直接，上記スラリー貯槽(3) に仕込み，超臨界溶媒に混合，分散させる。

【００３３】なお，本発明で使用する超臨界溶媒としては，臨界温度が常温すなわちおおよそ２５° Ｃ以上にあり，常温，大気圧の条件において液体で存在する溶媒を用いるのが好ましい。具体的には安価であり、毒性も無く、加水分解反応が極めて高速で進行する水が特に好ましいが，その他メタノール，エタノール等のアルコール類，ベンゼン，トルエン等の芳香族化合物類，アセトン等のケトン類，酢酸エチル等のエステル類などの溶媒が挙げられるが，これに限定されるものではない。また，複数の超臨界溶媒を混合して用いてもよい。

【００３４】上記スラリーは，高圧スラリーポンプ(7) により超臨界状態を形成する圧力まで加圧され，超臨界反応器(8) に送液される。必要な場合には，上記スラリーの送液と同時に溶媒，触媒，薬剤等貯槽(9) 内の流体を高圧液体ポンプ(10)により，超臨界状態を形成する圧力まで加圧し，超臨界反応器(8) に送液してもよい。

【００３５】上記超臨界反応器(8) 内は加熱ヒータ(14)により超臨界反応室(13)内が超臨界状態となる温度に加熱，調温され，また高圧調圧弁(v1)により超臨界状態となる圧力に保持されるようにしてある。なお，加熱ヒータ(14)の出力は，分解反応熱，酸化反応熱等による超臨界反応器(8) 内の温度上昇，あるいは温度低下の状況に応じて調節される。

【００３６】高圧スラリーポンプ(7) によって超臨界反応器(8) に送液されたスラリーは，スラリー予備加熱器(11)により超臨界状態を形成する所定の温度まで加熱され超臨界反応室(13)に入る。また，高圧液体ポンプ(10)により超臨界反応器(8) に送液された流体は溶媒，触媒，薬剤等予備加熱器(12)により超臨界状態を形成する所定の温度まで加熱され超臨界反応室(13)に入る。

【００３７】超臨界反応室(13)においては，超臨界流体による処理が行われる。すなわち，液晶パネル中のＴＦＴや透明電極に含まれる金属成分のうち，超臨界反応室(13)内の温度，圧力条件において溶解可能な物質は超臨界流体に溶解する。また液晶パネル中の液晶や偏光板，シール樹脂，スペーサーなどの樹脂成分は，低分子化合物への分解が起こり，生成した低分子化合物は超臨界流体に溶解する。超臨界流体による分解や溶解が起こらない，あるいは溶解しきれないガラスや金属等の成分は固体の状態を保つ。なお，上述の超臨界流体による分解，溶解においては，処理が超臨界流体中で行われるため，ダイオキシンを含む各種の有害副生成物はほとんど発生しない。

【００３８】上記超臨界反応室(13)で処理された生成物は，固体捕集室(15)に送られる。図１に示した超臨界反応器(8) を用い，該超臨界反応室(13)内に超臨界反応室撹拌掻出翼(17)等の生成物を固体捕集室(15)側に掻き出す機構を設置した場合には，該超臨界反応室撹拌掻出翼(17)を駆動することにより超臨界反応室(13)の出口方向に生成物を掻き出すことができる。また，超臨界反応器(8) として図２(b) に示したものを用いた場合には，上記固体のみが固体捕集室(15)に沈降し，超臨界流体と該超臨界流体に溶解した成分は，冷却器(18)に送液される。

【００３９】固体捕集室(15)では，分解生成物および超臨界流体に溶解する成分を含んだ超臨界流体と固体の分離が行われ，上記分解生成物と溶解成分を含んだ超臨界流体は冷却器(18)に送られ，固体は捕集され，固体回収用高温高圧バルブ(v2)を介して固体成分１として回収される。

【００４０】超臨界反応器(8) を出た生成物は，冷却器(18)により冷却され，固体捕集槽(19)に送られる。該固体捕集槽(19)内は固体捕集槽調温ジャケット(20)により所定の温度に調整するが，この場合，生成物の温度は超臨界流体の臨界温度以下となるようにする。該固体捕集槽(19)では超臨界流体の温度が下がることによって溶解度が小さくなり，そのため固体として析出した成分が固体成分２として捕集され，固体回収用高圧バルブ(v3)を介して回収される。固体捕集槽(19)内で析出しない成分については，超臨界溶媒と共に該固体捕集槽(19)から輸送される。

【００４１】上記固体捕集槽(19)を出た生成物は，高圧調圧弁(v1)により大気圧まで減圧された後，分離槽(21)に送られる。該分離槽(21)内は調温ジャケット(22)により所定の温度に調整されている。該分離槽(21)内においては，調温された温度，大気圧条件となることで析出した固体成分３，溶媒および溶媒可溶液体成分，溶媒不溶液体成分および気体成分が相分離し，それぞれ回収される。

【００４２】なお，本発明においては，所望により，該超臨界反応器(8) を複数並列に設置し，同時に処理を行い処理量の増大を図ってもよい。また，超臨界反応器(8) を複数直列に設置し，それぞれの該超臨界反応器(8) の温度を異なる温度に設定し，処理を段階的に行ってもよい。

【００４３】以下に粉砕した液晶パネルを，超臨界溶媒として水を用いて処理した場合を例に，目的の各種の回収物を得るための上記超臨界反応器(8) における温度，圧力条件について説明する。先ず，例えば液晶パネル中の金属成分を高収率で回収し，液晶および樹脂成分を容易に廃棄することができる極めて低分子の化合物に分解する処理のための条件について示す。この場合，超臨界反応器(8) の条件を比較的温度，圧力の高い条件，例えば臨界温度，臨界圧力より十分高温，高圧条件である温度７７３Ｋ，圧力３５ＭＰａ程度の状態に設定する。超臨界反応器(8)内では透明電極やＴＦＴに含まれるイン

ジウム等の金属やその酸化物等の金属成分の大半は超臨界流体に溶解する。また，液晶は，分子内のベンゼン環，シクロヘキサン環を結ぶ－ＣＯＯ－，－ＣＨ＝ＣＨ－，－$ＣＨ_２$ $ＣＨ_２$ －の結合が開裂し，さらにはベンゼン環，シクロヘキサン環自体の分解反応が起こり二酸化炭素，メタン，エタン，エチレン，メタノール，エタノール，エチレングリコール等の極めて低分子の化合物に分解され，超臨界流体中に溶解する。また，液晶パネル中の偏光板，シール樹脂，スペーサー，透明電極中の樹脂等の樹脂成分も上記液晶の場合と同様に極めて低分子の化合物に分解され，超臨界流体中へ溶解する。ガラスや超臨界流体より完全に溶解することができなかった一部の金属成分は固体の状態を保つ。

【００４４】上記の条件において，固体捕集室(15)からは液晶パネル内のガラスや超臨界流体に完全に溶解することができなかった一部の金属成分が固体成分１として回収される。該固体成分１は，酸洗いによるガラスと金属成分の分離工程，金属成分の製錬工程等の既存の所定のプロセスにより処理され，ガラスカレットおよび各々の金属として再利用、すなわちマテリアルリサイクルに供される。この場合，クロム，ヒ素，鉛等の有害と考えられる金属も全て回収し，既存の所定のプロセスにより処理する。また，回収された上記固体成分１や上記酸洗いによりガラスから分離した金属成分を本発明のスラリー貯槽（３）に供給し，さらに高温，高圧の条件で再度超臨界流体による処理を行うこともできる。固体捕集槽(19)には該固体捕集槽(19)の温度，圧力条件で超臨界溶媒に溶解できなくなった金属成分の固体が固体成分２として回収され，有害と考えられる金属も含め全て金属製錬工程等の既存の所定のプロセスにより処理され，各々の金属としてマテリアルリサイクルに供される。また，分離槽(21)からは該分離槽(21)の温度，大気圧の条件において超臨界溶媒に溶解できなくなった低分子化合物の固体，液体，気体がそれぞれ固体成分３，溶媒不溶液体成分，気体成分として，また溶媒に可溶な低分子化合物は溶媒および溶媒可溶液体成分として回収される。これらの化合物は極めて低分子の化合物であり，廃ガス処理工程，廃液処理工程等，既存の所定のプロセスにより処理される。また超臨界溶媒は，溶媒可溶液体成分と分離し，廃液処理工程により処理するか，あるいはシステムの超臨界溶媒としてリサイクルされる。

【００４５】上記条件で処理を行った場合には，金属成分が超臨界流体に溶解するものと溶解しないものに分離され，上記条件それぞれ固体成分１と固体成分２に得られるため，特に固体成分２の金属成分についてはガラスとの分離工程が必要ないこと，また，液晶および樹脂成分をダイオキシン等の有害物質を含まない極めて低分子の化合物に分解するため，有害物質を処理するための特殊な廃ガス処理工程，廃水処理工程を必要としない点が有効となる。

【００４６】次に，例えば液晶パネル中の液晶や偏光板，シール樹脂，スペーサー，透明電極中の樹脂等の樹脂成分を化成品原材料として，あるいは燃料としてリサイクルできる形態で高収率に回収するための処理の条件について示す。この場合，超臨界反応器(8) の条件を比較的温度，圧力の低い条件，例えば温度５９３Ｋ，圧力２０ＭＰａ程度の亜臨界状態に設定する。超臨界反応器(8) 内で液晶は分子内の弱い結合，例えば－ＣＯＯ－の結合が開裂し，ベンゼン環やシクロヘキサン環を骨格とする比較的高分子の分解生成物となり超臨界流体に溶解する。また，液晶パネル内の樹脂成分の分解反応も起こり，上記液晶の場合と同様に比較的高分子の化合物に分解される。また液晶パネル内の金属成分やガラスについては超臨界流体に溶解せず，固体の状態を保つ。

【００４７】上記の条件において，固体捕集室(15)からは液晶パネル内のガラスや金属成分が固体成分１として回収される。該固体成分１は，酸洗いによるガラスと金属成分の分離工程，金属成分の製錬工程等の既存の所定のプロセスにより処理され，ガラスカレットおよび各々の金属としてマテリアルリサイクルに供される。この場合，有害と考えられる金属も全て回収し，既存の所定のプロセスにより処理する。また，回収された上記固体成分１や上記酸洗いによりガラスから分離した金属成分を本発明のスラリー貯槽（３）に供給し，さらに高温，高圧の条件で再度超臨界流体による処理を行うこともできる。固体捕集槽(19)には該固体捕集槽(19)の温度，圧力において，超臨界溶媒に溶解できなくなった液晶や樹脂成分の分解生成物の固体が固体成分２として回収される。また，分離槽(21)からは該分離槽(21)の温度，大気圧の条件において超臨界溶媒に溶解できなくなった分解生成物が固体，液体，気体がそれぞれ固体成分３，溶媒不溶液体成分，ごく少量の気体成分として，また溶媒に可溶な分解生成物は溶媒および溶媒可溶液体成分として回収される。上記固体成分２，固体成分３，溶媒不溶液体成分および溶媒可溶液体成分は，液晶あるい樹脂に由来する比較的高分子量の化合物であり，各々あるいは一括して既存の所定のプロセスにより分離，精製し化成品の原材料としてマテリアルリサイクルするか，あるいは燃料として再利用する、すなわちサーマルリサイクルに供せられる。気体成分については既存の廃ガス処理工程にて処理される，また超臨界溶媒は，溶媒可溶液体成分と分離し，廃液処理工程により処理するか，あるいはシステムの超臨界溶媒としてリサイクルされる。

【００４８】上記条件で処理を行った場合には，気体成分の発生が小さいため，事実上，液晶パネルの全ての成分を回収できること，液晶や樹脂の分解生成物をマテリアルリサイクルあるいはサーマルリサイクルできる形態で高収率にて回収できる点，比較的温度，圧力の小さい条件で処理を行うため，システムの運転コストが小さい点が有効となる。

【００４９】なお，本発明において超臨界反応器(8) の温度，圧力の設定条件は上記の条件に限るものではなく，目的とする回収物を得るために適宜な温度圧力条件を設定して操作してよい。また，超臨界反応器(8) の温度，圧力を段階的，あるいは連続的に変化させて，操作してもよい。

【００５０】以下に液晶パネルを直接超臨界反応器(8) 内の超臨界反応室(13)に仕込む第２の方法について示す。この場合，図１に示した被処理物貯槽(1) ，粉砕機(2) ，スラリー貯槽(3),スラリー貯槽撹拌翼(4) ，超臨界溶媒貯槽(5) ，触媒，薬剤等貯槽(6) および高圧スラリーポンプ(7) は使用せず，高圧バルブ(v4)は閉じた状態で操作する。また，この場合，超臨界反応器(8) としては，図３(a) ，(b) ，(c) に示すように，超臨界反応器(8) の加熱ヒータ(14)の一部および超臨界反応室(13)の一部に開閉可能な加熱ヒータ蓋部(24)および超臨界反応室蓋部(25)を設けたものを用いる。

【００５１】処理すべき液晶パネルは，上記加熱ヒータ蓋部(24)および超臨界反応室蓋部(25)を開け，直接該超臨界反応器(8) 内の超臨界反応室(13)に仕込まれ，該加熱ヒータ蓋部(24)および超臨界反応室蓋部(25)を閉めることで超臨界反応器(8) 及び超臨界反応室(13)はそれぞれ密閉される。なお，この際図３(a) ，(b) ，(c) に示すように複数枚の液晶パネル(27)をホルダー(26)に装填，保持して超臨界反応室に仕込むようにしてもよい。また図３に示すように液晶パネル(27)は，流体の流れ方向に沿って配列するとよく，かつ多層に仕込むようにしてもよい。

【００５２】超臨界溶媒は，溶媒，触媒，薬剤等貯槽(9) から高圧液体ポンプ(10)により超臨界状態を形成する圧力まで加圧されて超臨界反応器(8) に供給される。この場合，所望により処理に必要となる触媒，酸化剤等の薬剤を超臨界溶媒と共に溶媒，触媒，薬剤等貯槽(9) から超臨界反応器(8) に供給してもよい。

【００５３】超臨界反応器(8) 内は加熱ヒータ(14)により超臨界反応室(13)内が超臨界状態となる温度に加熱，調温され，また高圧調圧弁(v1)により超臨界状態となる圧力に保持されるようにしてある。なお加熱ヒータの出力は，分解反応熱，酸化反応熱等による超臨界反応器(8) 内の温度上昇，あるいは温度低下の状況に応じて調節される。

【００５４】超臨界溶媒は，溶媒，触媒，薬剤等予備加熱器(12)により超臨界状態を形成する所定の温度まで加熱され超臨界流体となって超臨界反応室(13)に入り，処理が行われる。すなわち，液晶パネル中のＴＦＴや透明電極に含まれる金属成分のうち，超臨界反応室(13)内の温度，圧力条件において溶解可能な物質は超臨界流体に溶解する。また液晶パネル中の液晶や偏光板，シール樹脂，スペーサーなどの樹脂成分は，低分子化合物への分解が起こり，生成した低分子化合物は超臨界流体に溶解する。超臨界流体による分解や溶解が起こらない，あるいは溶解しきれないガラスや金属等の成分は固体の状態を保つ。なお，上記の超臨界流体による分解，溶解においては，超臨界流体中で処理を行うため，ダイオキシンを含む各種の有害副生成物はほとんど発生しない。

【００５５】液晶パネルの処理段階を詳述すると，超臨界反応室(13)内では，まず液晶パネル表面の偏光板が超臨界流体により分解，溶解処理される。同時に液晶パネルのカラーフィルタ基盤板ガラスとＴＦＴ基盤板ガラスを接着しているシール樹脂の分解，溶解が起こり，基盤板ガラスは剥離し，内側に封入されていた液晶，および内側面に存在している透明電極，ＴＦＴ，カラーフィルタ等が超臨界流体にさらされ分解，溶解処理されることとなる。また，この場合，ガラスは板ガラスとして超臨界反応器(8) 内に残り回収されることとなる。

【００５６】上記超臨界反応室(13)で処理された流体は，固体捕集室(15)に送られ，以下上述した第１の仕込み方法の場合とほぼ同様の処理を受ける。すなわち，図１に示すように，超臨界反応室(13)に超臨界反応室撹拌掻出翼(17)等の掻き出し機構を設置した場合には，該超臨界反応室撹拌掻出翼(17)を駆動することにより超臨界反応室(13)の出口方向に生成物を掻き出すこともできる。また，超臨界反応器(8) として図２(b) に示したものを用いた場合には，上記固体のみが固体捕集室(15)に沈降し，超臨界流体と該超臨界流体に溶解した成分は，冷却器(18)に送液される。

【００５７】固体捕集室(15)では，分解生成物および超臨界流体に溶解する成分を含んだ超臨界流体と固体の分離が行われ，上記分解生成物と溶解成分を含んだ超臨界流体は冷却器(18)に送られ，固体は捕集され，固体回収用高温高圧バルブ(v2)を介して固体成分１として回収される。

【００５８】超臨界反応器(8) を出た生成物は，冷却器(18)により冷却され，固体捕集槽(19)に送られる。該固体捕集槽(19)内は固体捕集槽調温ジャケット(20)により所定の温度に調整するが，この場合，生成物の温度は超臨界流体の臨界温度以下となるようにする。該固体捕集槽(19)においては超臨界流体の温度が下がることによって溶解度が小さくなり，そのため固体として析出した成分が固体成分２として捕集され，固体回収用高圧バルブ(v3)を介して回収される。固体捕集槽(19)内で析出しない成分については，超臨界溶媒と共に該固体捕集槽(19)から輸送される。

【００５９】上記固体捕集槽(19)を出た生成物は，高圧調圧弁(v1)により大気圧まで減圧された後，分離槽(21)に送られる。該分離槽(21)内は調温ジャケット(22)により所定の温度に調整されている。該分離槽(21)内においては，調温された温度，大気圧条件となることで析出した固体成分３，溶媒および溶媒可溶液体成分，溶媒不溶液体成分および気体成分が相分離し，それぞれ回収され

る。

【００６０】所定の時間超臨界流体による処理を行った後，高圧液体ポンプ(10)による溶媒等の送液を停止し，調圧弁(v1)を解放し超臨界反応器(8) 内を大気圧条件に戻した後，加熱ヒータ蓋部(24)，超臨界反応器蓋部(25)を開け，反応器内の固体成分を回収する。この際，上記液晶パネルは，直接超臨界反応器(8) 内に仕込まれているので，板ガラスをそのまま回収することができる。また複数枚の液晶パネルをホルダー(26)を用いて仕込んだ場合には，該ホルダー(26)と液晶パネル(27)を一括して回収することができる。得られた板ガラスは，既存の所定の処理法により，それぞれ分離され，マテリアルリサイクルに供される。

【００６１】なお，本発明において，超臨界反応器(8)を複数並列に設置し，同時に処理を行い処理量の増大を図ってもよい。また，超臨界反応器(8) を複数準備し，所定の数の反応器においては超臨界流体による処理を行い，その間に残りの反応器では仕込みを行っておく。前者の反応器における処理が完了した場合には，仕込みを行っておいた反応器での処理を開始し，処理が完了した反応器については，板ガラスの取り出し回収，仕込みを行うという操作を繰り返し，連続的な処理を行ってもよい。

【００６２】以下に液晶パネルを，超臨界反応室(13)に直接仕込み，超臨界溶媒として水を用いて処理した場合を例に，目的の各種の回収物を得るための上記超臨界反応器(8)における温度，圧力条件について説明する。先ず，超臨界反応器(8) の条件を比較的温度，圧力の高い条件，例えば臨界温度，臨界圧力より十分高温，高圧条件に設定した場合について示す。この場合，透明電極やＴＦＴに含まれるインジウム等の金属やその酸化物等の金属成分の大半は超臨界流体に溶解する。また，液晶や液晶パネル中の偏光板，シール樹脂，スペーサー，透明電極中の樹脂等の樹脂成分も二酸化炭素，メタン，エタン，エチレン，メタノール，エタノール，エチレングリコール等の極めて低分子の化合物に分解され，超臨界流体中に溶解すため，カラーフィルタ基盤板ガラスとＴＦＴ基盤板ガラスは透明な板ガラスとなる。超臨界流体より完全に溶解することができなかった一部の金属成分は固体の状態を保つ。

【００６３】上記の条件において，超臨界反応室(13)からは透明な板ガラスが回収され，マテリアルリサイクルに供せられる。固体捕集室(15)からは，超臨界流体に完全に溶解することができなかった一部の金属成分が固体成分１として回収され，既存の金属成分の製錬工程により処理され，各々の金属としてマテリアルリサイクルに供される。この場合，クロム，ヒ素，鉛等の有害と考えられる金属も全て回収し，既存の所定のプロセスにより処理する。また，回収された上記固体成分１や上記酸洗いによりガラスから分離した金属成分を本発明のスラリー貯槽（３）に供給し，さらに高温，高圧の条件で再度超臨界流体による処理を行うこともできる。固体捕集槽(19)には該固体捕集槽(19)の温度，圧力条件で超臨界溶媒に溶解できなくなった金属成分の固体が固体成分２として回収され，有害と考えられる金属も含め全て金属製錬工程等の既存の所定のプロセスにより処理され，各々の金属としてマテリアルリサイクルに供される。また，分離槽(21)からは該分離槽(21)の温度，大気圧の条件において超臨界溶媒に溶解できなくなった低分子化合物の固体，液体，気体がそれぞれ固体成分３，溶媒不溶液体成分，気体成分として，また溶媒に可溶な低分子化合物は溶媒および溶媒可溶液体成分として回収される。これらの化合物は極めて低分子の化合物であり，廃ガス処理工程，廃液処理工程等，既存の所定のプロセスにより処理される。また超臨界溶媒は，溶媒可溶液体成分と分離し，廃液処理工程により処理する。また上記超臨界溶媒はシステムの超臨界溶媒としてリサイクルしてもよい。

【００６４】上記条件で処理を行った場合には，ガラス，超臨界流体に溶解しない金属成分，超臨界流体に溶解する金属成分，低分子化合物等が分離され回収できること，また，液晶および樹脂成分をダイオキシン等の有害物質を含まない極めて低分子の化合物に分解するため，有害物質を処理するための特殊な廃ガス処理工程，廃水処理工程を必要としない点が有効となる。

【００６５】次に，超臨界反応器(8) の条件を比較的温度，圧力の低い条件，例えば亜臨界状態に設定した場合について示す。この場合，液晶や液晶パネル内の樹脂成分は比較的高分子の分解生成物となり，超臨界流体に溶解する。また液晶パネル内の金属成分は，透明電極中の樹脂成分が分解，溶解したためＴＦＴ基盤板ガラスから剥離した状態で固体の状態を保つ。またＴＦＴ基盤板ガラスは透明な板ガラスとして，カラーフィルタ基盤板ガラスはカラーフィルタが表面に保存された板ガラスとなる。

【００６６】上記の条件において，超臨界反応室(13)からは液晶パネル内の透明な板ガラスとカラーフィルター付きの板ガラスが回収されそれぞれマテリアルリサイクルに供せられる。固体捕集室(15)からは金属成分のみが固体成分１として回収され，金属成分の製錬工程等の既存の所定のプロセスにより処理されマテリアルリサイクルに供される。この場合，有害と考えられる金属も全て回収し，既存の所定のプロセスにより処理する。また，回収された上記固体成分１や上記酸洗いによりガラスから分離した金属成分を本発明のスラリー貯槽（３）に供給し，さらに高温，高圧の条件で再度超臨界流体による処理を行うこともできる。固体捕集槽(19)には該固体捕集槽(19)の温度，圧力において，超臨界溶媒に溶解できなくなった分解生成物の固体が固体成分２として回収される。また，分離槽(21)からは該分離槽(21)の温度，大気圧の条件において超臨界溶媒に溶解できなくなった分

解生成物が固体，液体，気体がそれぞれ固体成分３，溶媒不溶液体成分，ごく少量の気体成分として，また溶媒に可溶な分解生成物は溶媒および溶媒可溶液体成分として回収される。上記固体成分２，固体成分３，溶媒不溶液体成分および溶媒可溶液体成分は，液晶あるい樹脂に由来する比較的高分子量の化合物であり，各々あるいは一括して既存の所定のプロセスにより分離，精製し化成品の原材料としてマテリアルリサイクルするか，あるいは燃料としてサーマルリサイクルに供せられる。気体成分については既存の廃ガス処理工程にて処理される，また超臨界溶媒は，溶媒可溶液体成分と分離し，廃液処理工程により処理する。また上記超臨界溶媒は、システムの超臨界溶媒としてリサイクルされる。

【００６７】上記条件で処理を行った場合には，気体成分の発生が小さいため，事実上，液晶パネルの全ての成分を回収できること，液晶や樹脂の分解生成物をマテリアルリサイクルあるいはサーマルリサイクルできる形態で高収率にて回収できる点，比較的温度，圧力の小さい条件で処理を行うため，システムの運転コストが小さい点が有効となる。

【００６８】なお，本発明において超臨界反応器(8) の温度，圧力の設定条件は上記の条件に限るものではなく，目的とする回収物を得るために適宜な温度圧力条件を設定して操作してよい。また，超臨界反応器(8) の温度，圧力を段階的，あるいは連続的に変化させて，操作してもよい。

【００６９】

【実施例】本発明の実施例として，図３（ａ）の超臨界反応器を用い，上述した第２の方法，すなわち液晶パネルを直接超臨界反応器に仕込む方法で液晶パネルの処理を行った。上記処理においては超臨界流体として水を用い，触媒，酸化剤等の薬剤は加えず，超臨界反応器内の温度５９３Ｋ，圧力２５ＭＰａおよび温度６９３Ｋ，圧力３５ＭＰａで処理を行った。なお，処理する液晶パネルにはノートパソコン用ＴＦＴカラー液晶パネルを用いた。

【００７０】温度５９３Ｋ，圧力２５ＭＰａで行った処理では，処理後，超臨界反応室内より透明な板ガラスとカラーフィルタが残った板ガラスがそれぞれ回収された。回収された板ガラス表面には，液晶，偏光板，樹脂シール，透明電極等は全く観測されなかった。固体捕集室中には液晶パネルから剥離あるいは溶解したインジウム，酸化チタン等の金属成分が観測され，固体捕集槽にはビフェニル，メチルフェニルベンゼン等の芳香族化合物の結晶が比較的少量は観測された。また分離槽内の流体を分析したところ，メタノール，エタノール，ベンジルアルコール，アニソール，シクロヘキサノール等の液晶や樹脂が分解し，生成したと考えられる有機化合物が観測され，処理が良好に行えることが確認された。なお，この場合，気体成分の発生は非常に少ないが，二酸化炭素，およびメタンが少量観測された。

【００７１】温度６９３Ｋ，圧力３５ＭＰａで行った処理では，処理後，超臨界反応室内より２枚の透明な板ガラスが回収された。回収された板ガラス表面には，液晶，偏光板，樹脂シール，カラーフィルタ，透明電極等は全く観測されなかった。固体捕集室には酸化チタンが少量観測され，固体捕集槽からはＴＦＴ等から溶解したインジウム等の金属成分が観測された。また，分離槽内の流体を分析したところ，ジメチルエーテル，メタノール，エタノール，エチレングリコール，アセトアルデヒド等，液晶や樹脂が分解し，生成したと考えられる極低分子の有機化合物が観測され，処理が良好に行えることが確認された。この場合，気体成分としては二酸化炭素，メタン，エタン，水素等が得られた。

【００７２】

【発明の効果】本発明は上記のように構成され，液晶パネルを超臨界反応器内において超臨界流体により分解，溶解し，その生成物を完全に回収し，リサイクルに供することができる金属成分，ガラス，溶媒可溶液体成分，溶媒不溶液体成分，気体成分として回収することができる。本発明は，従来の処理方法を用いた場合に比較して，効率のよいリサイクル処理が行え，超臨界流体を用いて液晶パネルを分解，溶解し処理するため，有用成分を極めて高収率で回収することができ，特にインジウムを回収することができる。また，超臨界流体中で分解を行うため有害物質の発生を低減するため有害物を処理するための特別な工程を必要としないし，処理に際して液晶パネルのカラーフィルタ基盤板ガラスやＴＦＴ基盤板ガラスから偏光板を剥離するという工程や，カラーフィルタ基盤板ガラスとＴＦＴ基盤板ガラスを２枚に剥離するという工程を必要としないことなどから、処理が簡単で経済的に行うことができる。

【図面の簡単な説明】

【図１】本発明のリサイクル処理システムの一実施例を示す説明図。

【図２】本発明の構成の他の一実施例を示す説明図。

【図３】本発明の構成の他の一実施例を示す説明図。

【図４】液晶ディスプレーの構造の説明図。

【図５】液晶パネルの構造の説明図。

【図６】本発明で使用する超臨界流体を説明する超臨界状態の説明図。

【図７】水の超臨界流体の誘電率の説明図。

【図８】水の超臨界流体のイオン積の説明図。

【符号の説明】

1　被処理物貯槽
2　粉砕機
3　スラリー貯槽
4　スラリー貯槽撹拌翼
5　超臨界溶媒貯槽
6　触媒，薬剤等貯槽

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7　高圧スラリーポンプ
8　超臨界反応器
9　溶媒，触媒，薬剤等貯槽
１０　高圧液体ポンプ
１１　スラリー予備加熱器
１２　溶媒，触媒，薬剤等予備加熱器
１３　超臨界反応室
１４　加熱ヒータ
１５　固体捕集室
１６　高温高圧用撹拌軸シール
１７　超臨界反応室撹拌掻出翼
１８　冷却器
１９　固体捕集槽
２０　調温ジャケット
２１　分離槽
２２　調温ジャケット

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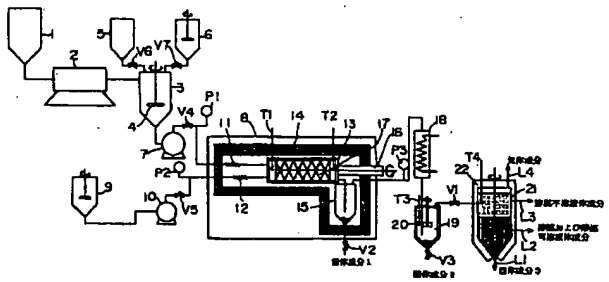
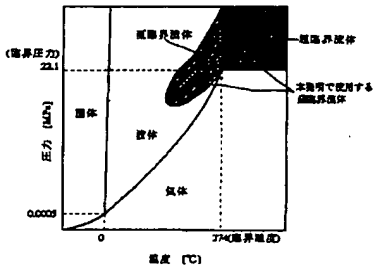
＊P1，P2，P3　圧力計
T1，T2，T3，T4　温度計
v1　高圧調圧弁
v2　固体回収用高温高圧バルブ
v3　固体回収用高圧バルブ
v4，v5　高圧バルブ
v6，v7　バルブ
L1　固体成分回収ライン
L2　溶媒および溶媒可溶液体成分回収ライン
L3　溶媒不溶液体成分回収ライン
L4　気体成分回収ライン
２３　仕切メッシュ
２４　加熱ヒータ蓋部
２５　超臨界反応室蓋部
２６　パネルホルダー
＊　２７　液晶パネル

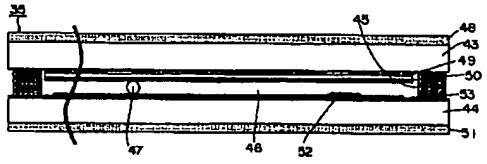
【図１】



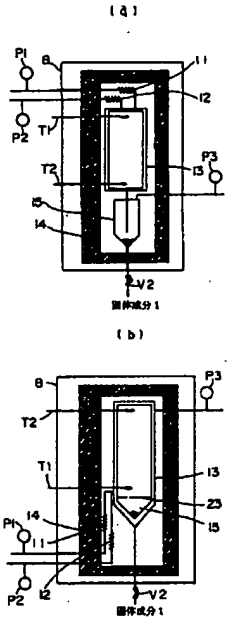
【図６】



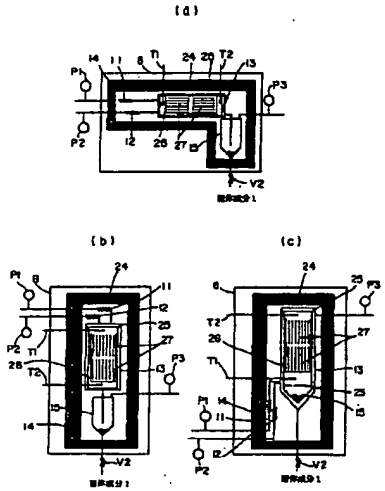
【図５】



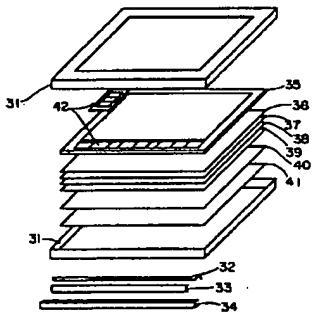
【図２】


(a)
P1
8
11
12
T1
P2
T2
P3
13
15
14
V2
固体成分１
(b)
8
P3
T2
T1
13
23
15
P1
14
11
P2
12
V2
固体成分１

【図３】


(d)
14
11
8
T1
24
26
T2
13
P1
P3
P2
12
28
27
V2
固体成分１
(b)
(c)
24
P1
8
11
12
25
27
P2
T1
28
T2
P3
13
15
14
V2
固体成分１
8
24
29
P3
T2
27
28
T1
13
25
15
P1
14
11
12
P2
V2
固体成分１

【図４】


31
42
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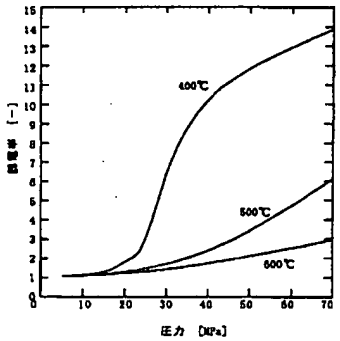
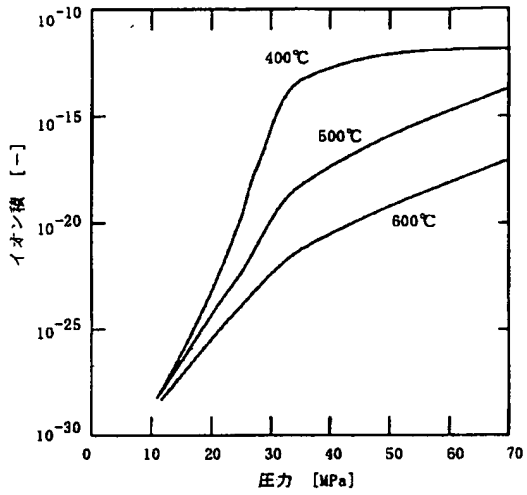
41
31
32
33
34

【図７】


400℃
500℃
600℃
圧力 [MPa]

【図８】



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CB27 CB31 CB32 CB42 CB43
CC03 CC09 CC20 DA01 DA02
DA06 DA07
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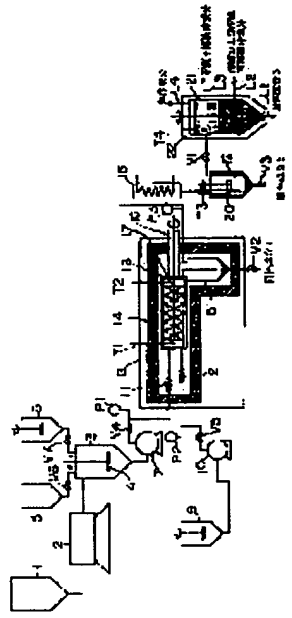
NISHI KAZUHIKO

(54) METHOD FOR RECYCLING TREATMENT OF LIQUID CRYSTAL PANEL AND SYSTEM FOR RECYCLING TREATMENT

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a method of recycling a liquid crystal panel and a system for the recycling process by which a liquid crystal panel can be efficiently processed, the effective components in the liquid crystal panel can be recovered at high yield, and discharge of harmful substances accompanied by the process can be decreased.
SOLUTION: The liquid crystal panel to be processed is sent to or put into a supercritical reaction chamber 13 in a supercritical reactor 8 without separating plastics or metals. The liquid crystal panel is decomposed and dissolved by a supercritical fluid in the supercritical reaction chamber 13. The decomposed and dissolved product in the supercritical fluid is sent to a solid trapping chamber 15 where a solid component 1 in the liquid crystal panel is recovered. Further the temperature of the product is decreased by a cooling device 18 and the product is sent to a solid trapping tank 19 where a crystallized solid component 2 in the liquid crystal panel is recovered. Then the pressure of the product is reduced to the atmospheric pressure through a high-pressure controlling valve V1 and the product is sent to a separation tank 21, where a solid component 3 in the liquid crystal panel is crystallized while the liquid crystal and the synthetic resin material in the liquid crystal panel are separated into phases of a solvent, solvent-soluble liquid component, solvent-insoluble liquid component and gas component and each component is recovered as a material for recycling.



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CLAIMS

[Claim(s)]
[Claim 1] The liquid crystal panel and supercritical solvent which should be processed in the supercritical reactor which is the recycle art of a liquid crystal panel and can create a supercritical place are supplied, heating pressurization of the inside of this supercritical reactor is carried out, and the above-mentioned supercritical solvent is made into supercritical fluid. By this supercritical fluid By disassembling the above-mentioned liquid crystal panel, dissolving, and cooling and decompressing the product The recycle art of the liquid crystal panel characterized by depositing the metal component in a liquid crystal panel etc., and separating the liquid crystal and the synthetic-resin ingredient in this liquid crystal panel as a low molecular weight compound etc., and obtaining the recyclable matter.
[Claim 2] The above-mentioned liquid crystal panel is the recycle art of the liquid crystal panel according to claim 1 which is ground, is mixed and distributed by the supercritical solvent, is pressurized by the critical pressure, and is supplied in the above-mentioned supercritical reactor.
[Claim 3] It is the recycle art of the liquid crystal panel according to claim 1 which the above-mentioned supercritical solvent is pressurized by the critical pressure, and is supplied to the above-mentioned supercritical reactor by supplying the above-mentioned liquid crystal panel directly in a supercritical reactor.
[Claim 4] It is the recycle art of the liquid crystal panel according to claim 1 which the above-mentioned liquid crystal panel which should carry out processing is the liquid crystal separated from the liquid crystal panel, including a circuit base, and the above-mentioned supercritical solvent is pressurized by the critical pressure, and is supplied to the above-mentioned supercritical reactor.
[Claim 5] A supercritical solvent is the recycle art of the liquid crystal panel according to claim 1 to 4 which is water.
[Claim 6] The matter collected from the above-mentioned liquid crystal panel is the recycle art of the liquid crystal panel according to claim 1 which is an indium.
[Claim 7] The recycle art of the liquid crystal panel according to claim 1 to 6 which collects the components which do not decompose and dissolve in the above-mentioned supercritical fluid within a supercritical reactor, cools the above-mentioned product below to critical temperature, collects metal components etc., decompresses to atmospheric pressure after that, and was made to carry out separation recovery of a gas component, solvent insoluble liquid component, solvent, and solvent meltable liquid component and the solid-state component.
[Claim 8] The liquid crystal panel which it is prepared in the supercritical reactor which is the recycle processing system of a liquid crystal panel, and can create a supercritical place, and should be processed, and the supercritical reaction chamber which contains a supercritical solvent, The heater which warms this supercritical solvent to high pressure pumping and critical temperature which pressurize the critical pressure so that this supercritical solvent may be made into supercritical fluid, The condensator which a liquid crystal panel is disassembled and dissolved by supercritical fluid in the above-mentioned supercritical reaction chamber, and cools the product, The recycle processing system of the liquid crystal panel characterized by providing

the solid-state uptake tub which collects the metal components in the liquid crystal panel which deposited below with critical temperature etc., and the separation tub which decompresses a product and collects the liquid crystal and the synthetic-resin ingredients in a liquid crystal panel as a low molecular weight compound etc. below to the critical pressure.
[Claim 9] The recycle processing system of the liquid crystal panel according to claim 8 which has the grinder which grinds the above-mentioned liquid crystal panel, the slurry tank dispersedly mixing and made into a slurry to the liquid crystal panel which had the supercritical solvent ground, and the high-pressure slurry pump which pressurizes the critical pressure and supplies this slurry to the above-mentioned supercritical reactor.
[Claim 10] The above-mentioned supercritical reactor and a supercritical reaction chamber are the recycle processing system of the liquid crystal panel according to claim 8 which has the high-pressure fluid pump which is formed possible [closing motion] so that the direct supply of the above-mentioned liquid crystal panel can be carried out, pressurizes the critical pressure and supplies a supercritical solvent to the above-mentioned supercritical reactor.
[Claim 11] The recycle processing system of the liquid crystal panel according to claim 9 which has further the high-pressure fluid pump which pressurizes the critical pressure and supplies a supercritical solvent to the above-mentioned supercritical reactor.
[Claim 12] The recycle processing system of the liquid crystal panel according to claim 8 to 11 with which the solid-state uptake room which collects the metal component which does not decompose and dissolve in the above-mentioned supercritical fluid, mineral matter, etc. is prepared in the above-mentioned supercritical reactor.
[Claim 13] The recycle processing system of the liquid crystal panel according to claim 8 with which churning ****** for carrying out churning **** of the product is prepared in the above-mentioned supercritical reactor.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention processes a liquid crystal panel, where discharge of harmful matter is reduced, disassembles liquid crystal and resin into a harmless low molecular weight compound as if the useful metal in a liquid crystal panel and glass are collected, and relates to the recycle art and recycle processing system to collect.
[0002] The liquid crystal display is used widely as display devices, such as current, a notebook sized personal computer, a video camera, a cellular phone, a calculator, and a clock. Furthermore, in recent years, development of an inside-of-a-house external use large-sized liquid crystal display, a liquid crystal television, etc. progresses, and the application and a volume are very large. These liquid crystal displays are in the present condition that it is discarded by failure, the life, or mold delay of the device to which the liquid crystal display besides failure of the liquid crystal display itself is connected, and the huge amount is discarded annually.
[0003] The outline of the TFT (Thin Film Transistor) method color liquid crystal display for personal computers is shown in drawing 4 as an example of the configuration of a liquid crystal display. The plastics chassis in drawing (31), a lamp (32), a lamp reflecting plate (33), A lamp cover (34), a diffusion sheet (36), and (39) A prism sheet (37) and (38) Although it reuses by the reuse as components and a light guide plate (40) and a reflective sheet (41) can reuse a liquid crystal display as a resource by dissolving and classifying Approaches enclosed with the liquid crystal panel (35) which constitutes the body of a liquid crystal display, and its interior, such as liquid crystal and a circuit base (42), are in the situation which is not established.
[0004] The cross-section schematic diagram of an example of the electrochromatic display panel of a TFT method used widely now is shown in drawing 5 . A liquid crystal panel (35) pastes up color filter base sheet glass (43) and TFT base sheet glass (44) by the seal resin (45) of an epoxy system, encloses the spacer (47) made of liquid crystal (46) and acrylic resin with the gap, and is constituted. The polarizing plate made of acrylic resin (48) has pasted the single-sided field of color filter base sheet glass (43), and the transparent electrode (50) containing red, blue, green, the color filter (49) that consists of black color material, and the orientation film to which orientation of the liquid crystal is carried out is installed in the field which touches liquid crystal. Moreover, the polarizing plate made of acrylic resin (51) has pasted up also like the single-sided side of TFT base sheet glass (44), and the transparent electrode (53) containing the orientation film and TFT (52) is installed in the field which touches liquid crystal.
[0005] The above-mentioned transparent electrode (ITO) (50) and (53) So that TFT (52) may generally be constituted in acrylic conductive resin It is produced. Inside, to metals, such as high added value useful metals, such as rare metals, such as an indium, and molybdenum, a tantalum, and noble metals, titanium, aluminum, tin, a tungsten, manganese, and germanium, and a pan as it is When discarded, metals, such as chromium which becomes harmful to an environment, an arsenic, lead, cadmium, and a gallium, exist. Moreover, although it divides roughly and a pneumatic liquid crystal, a smectic liquid crystal, and a ferroelectric liquid crystal are used as the above-mentioned liquid crystal, as for all of those matter, the benzene ring and the cyclohexane ring which were embellished with the straight chain alkyl group or the cyano group having the

basic structure of the shape of a straight chain connected with association of -COO-, -CH=CH-, and -CH2CH2-, and having toxicity about some liquid crystal is known. Moreover, generally the liquid crystal display mixes and uses two or more liquid crystal matter.
[0006] Collect in recycle processing of a liquid crystal panel in a transparent electrode, the rare metal contained in TFT, noble metals, and the condition that high added value useful metal components, such as an indium, are especially reusable. Disassemble liquid crystal into the harmless low molecular weight compound which can be discarded or reused. Decompose resinous principles, such as a polarizing plate, seal resin, a spacer, and a transparent electrode, into the harmless low molecular weight compound which can be discarded or reused. Although to collect in the state of the condition of the sheet glass which can reuse glass, such as color filter base sheet glass and TFT base sheet glass, or a glass caret is demanded, it cannot be said that these matters are enough filled with the approach of the conventional liquid crystal panel which carries out the following.
[0007] It reclaimed land from the liquid crystal panel until now, or it has been processed by incineration. By the approach of processing a liquid crystal panel by reclamation, in order to discard without collecting the useful component which exists in a liquid crystal panel, i.e., a rare metal, noble metals, and resinous principles, it becomes a problem from a viewpoint of resource reuse and a deployment. The soil pollution by the liquid crystal and the heavy metal compound which flow out of the liquid crystal panel from which it reclaimed land is also a big problem. A liquid crystal panel is put into the container of corrosion resistance, and although the approach from which it reclaims land to the abandoned mine of a mine is also taken, it cannot be said as fundamental processing of a liquid crystal panel.
[0008] Since it burns without collecting enough the useful components which exist in a liquid crystal display by the approach of incinerating and processing a liquid crystal panel, it becomes a problem from a viewpoint of resource reuse and a deployment, and also it is a problem to generate the harmful matter which contains dioxin at the time of combustion.
[0009] although the method of suppress generation of harmful matter, such as dioxin, and collect a zinc oxide, a metal melting lump, and slags by mix a liquid crystal panel with steel manufacture dust, coal, etc. in the furnace of a high temperature service 1000 degrees C or more, and burn be also propose, in order to use that a processor become very large-scale and coal for a combustion fuel, the viewpoint of energy saving and the point of increase the carbon dioxide levels in air pose a problem.
[0010] Although there is also a method of manufacturing a tile and the construction aggregate by grinding a liquid crystal panel, mixing with clay by special combination, and calcinating at the temperature of about 900 degrees C In the law, a liquid crystal panel Before grinding, exfoliate and the color filter base sheet glass and TFT base sheet glass of a liquid crystal panel are made to separate beforehand, it is required to exfoliate the polarizing plate on each base sheet glass further, the special equipment for it is required, and a problem is as an approach of processing a liquid crystal panel in large quantities. Moreover, the point that processing of the exfoliative polarizing plate or liquid crystal is not taken into consideration is also a problem.
[0011]
[Problem(s) to be Solved by the Invention] While the solution technical problem of this invention processes a liquid crystal panel where discharge of harmful matter is reduced, and collecting the useful metal in a liquid crystal panel, and glass, it is in offering the recycle art and recycle processing system of a liquid crystal panel which decompose into a harmless low molecular weight compound, and enabled it to collect liquid crystal and resin.
[0012]
[Means for Solving the Problem] According to this invention, the solubility to a metal metallurgy group oxide is large, it is extremely rich in reactivity to the decomposition reaction of the organic substance, such as liquid crystal and resin, and the solubility to the organic substance is also large, and the approach and system which process a liquid crystal panel using the property of the supercritical fluid which can change the reactivity and solubility promptly continuously are offered by changing a pressure and temperature. That is, it sets to the supercritical reactor which can create a supercritical condition, and the useful metal components in a liquid crystal

panel etc. are dissolved and collected, and the liquid crystal in a liquid crystal panel is disassembled into a harmless low molecular weight compound, the recycle art and recycle processing system of a liquid crystal panel using the supercritical fluid characterized by decomposing and collecting the resinous principles in a liquid crystal panel further to the low-molecular organic compound which constitutes each resin are offered, and the above-mentioned technical problem is solved.
[0013] In addition, in this invention, as a supercritical solvent means the solvent for making a supercritical condition and it is shown in drawing 6 , even if it is in a condition which is slightly less than such critical temperature besides the so-called supercritical condition which exceeded critical temperature and the critical pressure on the temperature-pressure phase diagram as a supercritical condition and supercritical fluid, and supercritical fluid, and the critical pressure, a supercritical condition, the subcritical state which has the same capacity as supercritical fluid, and a subcritical fluid shall be included on the solubility to reactivity and the matter.
[0014] Water is explained to an example about the property of supercritical fluid. Generally the dissolution rate and solubility to a solvent of the matter increase to temperature. Therefore, as compared with the solvent of a room temperature, the dissolution rate and solubility to a solvent of the matter become large in the supercritical condition in a hot condition as compared with the solvent of ordinary temperature. Drawing 7 shows the relation between a pressure and the dielectric constant of water about some temperature. A dielectric constant is an index which shows the polarity which the matter has here, and it turns out that the polarity of water becomes large by enlarging a pressure and considering as a supercritical condition. Thus, in supercritical fluid with a large polarity, the dissolution rate and solubility of the matter become [a dielectric constant] large greatly about both metal metallurgy group oxide and organic compound.
[0015] Drawing 8 shows a pressure and the relation of the ionic product of water about some temperature. The ionic product of water is a product of underwater hydrogen ion concentration and hydroxide-ion concentration, and is enlarging a pressure and considering as a supercritical condition here, and the ionic product of water becomes large. Thus, in supercritical fluid with a large ionic product, in order that a hydrogen ion may work as an acid and the hydroxide ion may work as alkali, the dissolution rate of a metal metallurgy group oxide and solubility become large.
[0016] Moreover, generally various kinds of reaction rates increase exponentially to temperature. Therefore, in the supercritical condition which is in a hot condition as compared with the solvent of a room temperature, it happens at high speed as compared with the case where various kinds of reactions are ordinary temperature. As furthermore shown in drawing 7 , the polarity of water becomes large by enlarging a pressure and considering as a supercritical condition, and in such supercritical fluid, the reaction rate of ion-reactions, such as a hydrolysis reaction of resin or the organic substance, becomes large. Moreover, in order that the ionic product of water may become large by enlarging a pressure like drawing 8 and considering as a supercritical condition, and the reaction rate of an ion-reaction may become large into such supercritical fluid, and also a hydrogen ion may work as an acid and the hydroxide ion may work as alkali, the reaction rate of both of acid catalyzed reaction and alkali catalytic reaction becomes large.
[0017] When a liquid crystal panel exists in the supercritical fluid which has the description which was described above, most metal components containing high added value useful metals, such as an indium contained in a transparent electrode or TFT, will be dissolved in supercritical fluid. Moreover, the straight chain alkyl group and cyano group which embellish association of -COO- of the intramolecular, -CH=CH-, -CH2CH2-, etc., the benzene ring, and a cyclohexane ring cleave by reactions, such as hydrolysis and a pyrolysis, further, the benzene ring or the cyclohexane ring itself is quickly decomposed into the low-molecular organic compound which makes the benzene ring or a cyclohexane ring a frame, and the liquid crystal in a liquid crystal panel is dissolved in it by supercritical fluid. It will decompose into the low molecular weight compound which constitutes resin altogether out of supercritical fluid quickly, and acrylic, such as a polarizing plate in a liquid crystal panel, a resin seal, a spacer, and a transparent electrode, and epoxy system resin will dissolve into supercritical fluid. Decomposition by supercritical fluid, such as inorganic substances, such as color material contained in color filter base sheet glass,

TFT base sheet glass, and a color filter, and the dissolution will separate a difficult component with a metal component and a resinous principle, and it will remain into supercritical fluid as a solid-state. Or the low-molecular organic compound metallurgy group which dissolved in the supercritical fluid furthermore dissolved lowers temperature, it can be promptly dissociated or deposited from supercritical fluid by making a pressure small.
[0018]
[Embodiment of the Invention] Drawing 1 is the explanatory view showing one example of the recycle processing system of the liquid crystal panel of this invention. Processed material tank which contains the liquid crystal panel which should be processed in this drawing (1) Grinder which grinds a liquid crystal panel (2) It is connected. This grinder (2) Catalyst which is needed for the liquid crystal panel, the supercritical solvent, and processing which were ground, Slurry tank for mixing drugs, such as an oxidizer, and containing as a slurry (3) It is connected. in addition, this grinder (2) ****** -- a liquid crystal panel is beforehand cooled and frozen in liquid nitrogen etc., and the existing equipments, such as a coarse crusher equivalent to a fracture machine and a grinder which is efficient and performs grinding, can be used.
[0019] the above-mentioned slurry tank (3) **** -- supercritical solvent tank (5) which contains a supercritical solvent Catalyst which is connected through a bulb (v6) and is needed for processing, Tanks (6), such as a catalyst, drugs, etc. which contain drugs, such as an oxidizing agent, It is connected through the bulb (v7). moreover, this slurry tank (3) **** -- slurry tank impeller (4) for mixing drugs, such as a liquid crystal panel which should be processed, a supercritical solvent and the catalyst which is needed for processing, and an oxidizer, distributing, and preparing to a slurry It is installed. The above-mentioned slurry tank (3) Supercritical reactor which creates a supercritical condition and performs processing by supercritical fluid (8) High-pressure slurry pump to connect (7) It is connected.
[0020] the above-mentioned supercritical reactor (8) **** -- tanks (9), such as a solvent which contains drugs which are needed for a supercritical solvent or processing, such as a catalyst and an oxidizer, a catalyst, and drugs, High pressure pumping (10) to connect is connected through the high-pressure bulb (v5). Moreover, this supercritical reactor (8) The solid-state uptake tub (19) is connected with the delivery through the condensator (18) for lowering the temperature of a product and supercritical fluid. In addition, this supercritical reactor (8) In the inlet-port section and the outlet section, it is this supercritical reactor (8). The pressure gage (P1) for observing an inner pressure, (P2), and (P3) are installed.
[0021] the above-mentioned supercritical reactor (8) ****** -- the postscript of everything but the configuration shown in drawing 1 is carried out -- as -- drawing 2 (a) (b) And drawing 3 R> 3 (a) (b) (c) The shown configuration can be used. supercritical reactor (8) shown in drawing 1 **** -- this supercritical reactor (8) The heating heater (14) for heating inside more than critical temperature is installed. Moreover, this supercritical reactor (8) The supercritical reaction chamber which performs processing by supercritical fluid inside (13), This supercritical reaction chamber (13) and the above-mentioned high-pressure slurry pump (7) The slurry preheater which heats the slurry which connects through a high-pressure bulb (v4), and contains a liquid crystal panel more than critical temperature (11), Preheaters, such as a solvent which heats drugs which connect this supercritical reaction chamber (13) and the above-mentioned high pressure pumping (10), and are needed for processing of a solvent and a liquid crystal panel, such as a catalyst and an oxidizer, more than critical temperature, a catalyst, and drugs (12), The solid-state uptake room (15) which carries out uptake of the solid-state component 1 in the product generated by processing is installed.
[0022] The device which rakes out exactly products, such as supercritical reaction chamber churning ****** (17) driven through elevated-temperature high-pressure churning shaft sealing (16), can also be installed in the above-mentioned supercritical reaction chamber (13). Moreover, the thermometer (T1) which observes the temperature in this supercritical reaction chamber (13), and (T2) are installed in the inlet-port section of this supercritical reaction chamber (13), and the outlet section. In addition, things of a non seal mold, such as a thing using the alternating current external magnetic field besides mechanical seal as the above-mentioned churning shaft sealing for elevated-temperature high pressures (16) or a thing which transmits the driving force

of a motor to an impeller with a permanent magnet, may be used.
[0023] Moreover, the above-mentioned solid-state uptake room (15) is the above-mentioned supercritical reactor (8). It has connected with the above-mentioned condensator (18) installed outside, and the elevated-temperature high-pressure bulb for solid-state recovery (v2) is installed in the exhaust port of this solid-state uptake room (15). In the example shown in drawing 1 as this solid-state uptake room (15), although the particle settling tank format is used, a centrifugal field can be used, and the thing of the cyclone format which carries out uptake only of the solid-state to the pars basilaris ossis occipitalis of the above-mentioned solid-state uptake room (15) etc. can also be used.
[0024] Drawing 2 (a) Shown supercritical reactor (8) Supercritical reactor shown in drawing 1 (8) It constitutes in the gestalt of a longwise tub type or a column type, and installation area is made small. this supercritical reactor (8) **** -- preheaters (12), such as a slurry preheater (11), a solvent, a catalyst, and drugs, -- supercritical reaction chamber (13). The heating heater (14), the solid-state uptake room (15), etc. possess, and the above-mentioned slurry is a supercritical criticality reactor (8). It is this supercritical reactor (8) from the upper part. It enters, and it is constituted so that the liquid may be sent by the solid-state uptake room (15) connected to a condensator (18) from a lower part. In addition, the above-mentioned supercritical reactor (8) It does not necessarily need to be constituted and installed perpendicularly and you may install at an angle of arbitration.
[0025] Moreover, drawing 2 (b) Shown supercritical reactor (8) A batch mesh (23) is prepared in the pars basilaris ossis occipitalis of a supercritical reaction chamber (13), and inside, partition formation of the solid-state uptake room (15) is carried out, and it considers as the structure of one apparatus. this supercritical reactor (8) **** -- preheaters (12), such as a slurry preheater (11), a solvent, a catalyst, and drugs, -- supercritical reaction chamber (13) And a heating heater (14) etc. possesses, and the above-mentioned slurry goes into this supercritical reaction chamber (13) from the upper part of the above-mentioned batch mesh (23) which divides a supercritical reaction chamber (13) and a solid-state uptake room (15), and it is constituted so that the liquid may be sent by the condensator (18) from the upper part of a supercritical reaction chamber (13). In addition, the above-mentioned supercritical reactor (8) It does not necessarily need to be constituted and installed perpendicularly and you may install at an angle of arbitration.
[0026] further -- again -- supercritical reactor (8) ****** -- drawing 3 R> 3 (a) (b) (c) So that it may be shown Drawing 1 and drawing 2 (a) (b) The shown above-mentioned supercritical reactor (8) In order to teach the liquid crystal panel which should be processed directly to some heating heaters (14) and a part of supercritical reaction chamber (13) The thing in which the heating heater covering device (24) and supercritical reaction chamber covering device (25) which can be opened and closed were formed can also be used.
[0027] the above-mentioned solid-state uptake tub (19) connected with the above-mentioned condensator (18) **** -- The thermometer for observing the temperature in this solid-state uptake tub (19) (T3). The temperature control jacket (20) for carrying out temperature control of the inside of this solid-state uptake tub (19) is installed. To an exhaust port with a condensator (18) and a temperature control jacket (20) temperature fell -- the high-pressure bulb for solid-state recovery for collecting the solid-state components 2 which deposited from the supercritical solvent (v3) is installed. This solid-state uptake tub (19) is connected with the separation tub (21) for separating and collecting the products generated by processing through a high-pressure pressure regulating valve (v1). In addition, the thing and centrifugal field of a particle settling tank format which were shown in drawing 1 as the above-mentioned solid-state uptake tub (19) are used, and the thing of the thing of the cyclone format which carries out uptake only of the solid-state to the pars basilaris ossis occipitalis of the above-mentioned solid-state uptake tub (19), or the format which installed the impeller in the cyclone format further and the separability ability of the solid-state by the centrifugal force and a liquid raised etc. can be used.
[0028] The thermometer (T four) which observes the temperature in this separation tub (21), and the temperature control jacket (22) which carries out temperature control of the inside of this

separation tub (21) are installed in the above-mentioned separation tub (21). Moreover, solid-state component recovery Rhine for collecting respectively a solid-state component [which was separated when a pressure declined with a high-pressure pressure regulating valve (v1)] 3, solvent, and solvent meltable liquid component, a solvent insoluble liquid component, and gas components (L1), Solvent and solvent meltable liquid component recovery Rhine (L2), solvent insoluble liquid component recovery Rhine (L3), and gas component recovery Rhine (L4) have connected.
[0029] In order to ** and to process a liquid crystal panel using the above-mentioned system It is a processed material tank (1) about the liquid crystal panel which should be processed. It teaches and is a grinder (2). It grinds and is a slurry tank (3). After setting and adjusting to a slurry Supercritical reactor (8) The 1st approach of supplying. It is a direct and supercritical reactor (8) about the liquid crystal panel which should be processed. The 2nd approach of teaching an inner supercritical reaction chamber (13) can be taken.
[0030] Separation from the liquid crystal panel (35) indicated to be the liquid crystal panel which should be processed here to drawing 4 , or this liquid crystal panel may be a thing including a difficult circuit base (42), or the liquid crystal (46) separately separated from the liquid crystal panel (35) by technique.
[0031] The 1st approach is shown below. the liquid crystal panel which should be processed -- processed material tank (1) from -- grinder (2) It is sent. This grinder (2) It is ground to the particle size of extent decomposed and dissolved easily, predetermined magnitude, i.e., supercritical fluid which carries out a postscript.
[0032] The ground liquid crystal panel is a slurry tank (3). It is sent. this slurry tank (3) -- this slurry tank (3) Installed slurry tank impeller (4) Supercritical solvent tank (5) from -- the supercritical solvent and liquid crystal panel which are supplied are mixed, and it distributes, and is prepared by the slurry. In this case, catalyst which is needed for processing when wished especially, They are tanks (6), such as a catalyst and drugs, about drugs, such as an oxidizer. Rally tank (3) It may supply and a slurry may be prepared. Moreover, when processing the liquid crystal itself separated from the liquid crystal panel, it is the direct and above-mentioned slurry tank (3) about liquid crystal. It teaches, and it mixes to a supercritical solvent and it is distributed.
[0033] In addition, as a supercritical solvent used by this invention, it is desirable that critical temperature uses ordinary temperature, i.e., the solvent which exists about more than 25-degreeC and exists with a liquid in ordinary temperature and the conditions of atmospheric pressure. It is specifically cheap and there is also no toxicity, and although especially the water with which a hydrolysis reaction advances extremely at high speed is desirable, in addition although solvents, such as ester, such as ketones, such as aromatic compounds, such as alcohols, such as a methanol and ethanol, benzene, and toluene, and an acetone, and ethyl acetate, are mentioned, it is not limited to this. Moreover, two or more supercritical solvents may be mixed and used.
[0034] The above-mentioned slurry, High-pressure slurry pump (7) It is pressurized to the pressure which forms a supercritical condition, and is a supercritical reactor (8). The liquid is sent. When required, they are tanks (9), such as a solvent, a catalyst, and drugs, to liquid sending and coincidence of the above-mentioned slurry. An inner fluid is pressurized with a high-pressure liquid pump (10) to the pressure which forms a supercritical condition, and it is a supercritical reactor (8). The liquid may be sent.
[0035] The above-mentioned supercritical reactor (8) It is made to be held to the temperature from which the inside of a supercritical reaction chamber (13) will be in a supercritical condition at a heating heater (14) by inside at heating and the pressure which temperature control is carried out and will be in a supercritical condition with a high-pressure pressure regulating valve (v1). In addition, the output of a heating heater (14) is a supercritical reactor (8) by decomposition reaction heat, oxidation heat of reaction, etc. It is adjusted according to an inner temperature rise or the situation of a temperature fall.
[0036] High-pressure slurry pump (7) Supercritical reactor (8) The sent slurry is heated to the predetermined temperature which forms a supercritical condition by the slurry preheater (11),

and goes into a supercritical reaction chamber (13). Moreover, it is a supercritical reactor (8) by the high-pressure liquid pump (10). The sent fluid is heated to the predetermined temperature which forms a supercritical condition by preheaters (12), such as a solvent, a catalyst, and drugs, and goes into a supercritical reaction chamber (13).
[0037] Processing by supercritical fluid is performed in a supercritical reaction chamber (13). That is, in the temperature in a supercritical reaction chamber (13), and a flow and pressure requirement, the matter which can dissolve dissolves in supercritical fluid among the metal components contained in TFT and the transparent electrode in a liquid crystal panel. Moreover, the low molecular weight compound which resinous principles, such as the liquid crystal and the polarizing plate in a liquid crystal panel, seal resin, and a spacer, happened, and the decomposition to a low molecular weight compound generated is dissolved in supercritical fluid. Components, such as a glass metallurgy group which the decomposition or the dissolution by supercritical fluid do not take place, or cannot dissolve, maintain a solid condition. In addition, in decomposition by above-mentioned supercritical fluid, and the dissolution, since processing is performed in supercritical fluid, various kinds of harmful by-products containing dioxin are hardly generated.
[0038] The product processed in the above-mentioned supercritical reaction chamber (13) is sent to a solid-state uptake room (15). Supercritical reactor shown in drawing 1 (8) It uses, and when the device which rakes out products, such as supercritical reaction chamber churning ****** (17), to a solid-state uptake room (15) side is installed in this supercritical reaction chamber (13), a product can be raked out in the direction of an outlet of a supercritical reaction chamber (13) by driving this supercritical reaction chamber churning ****** (17). Moreover, supercritical reactor (8) It carries out and is drawing 2 (b). When what was shown is used, the component which only the above-mentioned solid-state sedimented in the solid-state uptake room (15), and dissolved in supercritical fluid and this supercritical fluid is sent by the condensator (18).
[0039] At a solid-state uptake room (15), separation of the supercritical fluid and the solid-state containing the component which dissolves in a decomposition product and supercritical fluid is performed, the supercritical fluid containing the above-mentioned decomposition product and a dissolution component is sent to a condensator (18), uptake of the solid-state is carried out and they are collected as a solid-state component 1 through the elevated-temperature high-pressure bulb for solid-state recovery (v2).
[0040] Supercritical reactor (8) It is cooled by the condensator (18) and the product which came out is sent to a solid-state uptake tub (19). Although a solid-state uptake tub temperature control jacket (20) adjusts the inside of this solid-state uptake tub (19) to predetermined temperature, it is made for the temperature of a product to become below the critical temperature of supercritical fluid in this case. In this solid-state uptake tub (19), when the temperature of supercritical fluid falls, solubility becomes small, therefore uptake of the component which deposited as a solid-state is carried out as a solid-state component 2, and it is collected through the high-pressure bulb for solid-state recovery (v3). About the component which does not deposit within a solid-state uptake tub (19), it is conveyed from this solid-state uptake tub (19) with a supercritical solvent.
[0041] After the product which came out of the above-mentioned solid-state uptake tub (19) is decompressed to atmospheric pressure by the high-pressure pressure regulating valve (v1), it is sent to a separation tub (21). The inside of this separation tub (21) is adjusted to predetermined temperature by the temperature control jacket (22). A temperature [by which temperature control was carried out into this separation tub (21)], solid-state component [which deposited by becoming atmospheric pressure conditions] 3, solvent, and solvent meltable liquid component, a solvent insoluble liquid component, and a gas component carry out phase separation, and are collected, respectively.
[0042] In addition, it sets to this invention and is this supercritical reactor (8) by request. It installs in two or more juxtaposition, Increase of deed throughput may be aimed at for processing to coincidence. Moreover, supercritical reactor (8) It installs in two or more serials, This each supercritical reactor (8) You may process gradually by setting temperature as different

temperature.
[0043] The above-mentioned supercritical reactor for acquiring for an example the case where the liquid crystal panel ground below is processed using water as a supercritical solvent for various kinds of target recovery objects (8) The temperature and the flow and pressure requirement which can be set are explained. First, the metal components in a liquid crystal panel are collected by high yield, for example, and the conditions for the processing decomposed into the very low-molecular compound which can discard liquid crystal and a resinous principle easily are shown. In this case, supercritical reactor (8) Conditions are set as the condition of temperature 773K and pressure 35MPa extent which are an elevated temperature and high-pressure conditions enough from the conditions, for example, critical temperature, that temperature and a pressure are comparatively high, and the critical pressure. Within a supercritical reactor (8), most metal components, such as metals, such as an indium contained in a transparent electrode or TFT, and an oxide of those, are dissolved in supercritical fluid. Moreover, association of -COO- which connects the benzene ring of intramolecular and a cyclohexane ring, -CH=CH-, and -CH2CH2- cleaves, and the decomposition reaction of the benzene ring and the cyclohexane ring itself occurs further, it is decomposed into very low-molecular compounds, such as a carbon dioxide, methane, ethane, ethylene, a methanol, ethanol, and ethylene glycol, and liquid crystal dissolves into supercritical fluid. Moreover, it is decomposed into a very low-molecular compound like the case of the above-mentioned liquid crystal, and resinous principles, such as resin in the polarizing plate in a liquid crystal panel, seal resin, a spacer, and a transparent electrode, are also dissolved into supercritical fluid. Some metal components which were not able to dissolve more completely than glass or supercritical fluid maintain a solid condition.
[0044] In the above-mentioned conditions, some metal components which were not able to dissolve in glass or supercritical fluid in a liquid crystal panel completely are collected from a solid-state uptake room (15) as a solid-state component 1. This solid-state component 1 is processed according to the existing predetermined processes, such as a separation process of the glass by pickling, and a metal component, and a refinement process of a metal component, and reuse, i.e., material recycle, is presented with it as a glass caret and each metal. In this case, all the metals considered that chromium, an arsenic, lead, etc. are harmful are also collected, and it processes according to the existing predetermined process. Moreover, the metal component separated from glass by the collected above-mentioned solid-state component 1 or the above-mentioned pickling can be supplied to the slurry tank (3) of this invention, and processing by supercritical fluid can also be further performed again on an elevated temperature and high-pressure conditions. The temperature of this solid-state uptake tub (19) and the solid-states of a metal component it became impossible to dissolve in a supercritical solvent by the flow and pressure requirement are collected by the solid-state uptake tub (19) as a solid-state component 2, all are processed according to the existing predetermined processes, such as a refinement process, also including the metal considered to be harmful, and material recycle is presented as each metal. Moreover, as for a low molecular weight compound respectively meltable to the solvent as the solid-state component 3, a solvent insoluble liquid component, and a gas component, the solid-state of a low molecular weight compound it became impossible to dissolve in a supercritical solvent in the temperature of this separation tub (21) and the conditions of atmospheric pressure from a separation tub (21), a liquid, and gases are collected as a solvent and solvent meltable liquid component. These compounds are very low-molecular compounds, and are processed according to the existing predetermined processes, such as waste gas down stream processing and waste fluid down stream processing. Moreover, it dissociates with a solvent meltable liquid component, and a supercritical solvent is processed by waste fluid down stream processing, or is recycled as a supercritical solvent of a system.
[0045] when it processes on the above-mentioned conditions, it separates into what a metal component dissolves in supercritical fluid, and the thing which is not dissolved -- having -- each of above-mentioned conditions, since it is obtained by the solid-state component 1 and the solid-state component 2 In order to decompose into the very low-molecular compound which does not contain harmful matter, such as dioxin, for that a separation process is unnecessary.

liquid crystal, and a resinous principle with glass especially about the metal component of the solid-state component 2. The point which does not need special waste gas down stream processing for processing harmful matter and a waste-water-treatment process becomes effective.

[0046] Next, the conditions of the processing for collecting to high yield with a gestalt recyclable [, for example] as a fuel by making resinous principles, such as resin in the liquid crystal and the polarizing plate in a liquid crystal panel, seal resin, a spacer, and a transparent electrode, into a coal chemical product raw material or are shown. In this case, supercritical reactor (8) Conditions are set as the subcritical state of the conditions, temperature 593K [for example,], that temperature and a pressure are comparatively low, and pressure 20MPa extent. Supercritical reactor (8) The weak coupling of intramolecular, for example, association of -COO-, cleaves inside, and liquid crystal serves as a decomposition product of the comparison-macromolecule which makes the benzene ring and a cyclohexane ring a frame, and dissolves in supercritical fluid. Moreover, the decomposition reaction of the resinous principle in a liquid crystal panel also occurs, and it is comparatively decomposed into the compound of a macromolecule like the case of the above-mentioned liquid crystal. Moreover, about the metal component or glass in a liquid crystal panel, it does not dissolve in supercritical fluid, but a solid condition is maintained.

[0047] In the above-mentioned conditions, the glass metallurgy group components in a liquid crystal panel are collected from a solid-state uptake room (15) as a solid-state component 1. This solid-state component 1 is processed according to the existing predetermined processes, such as a separation process of the glass by pickling, and a metal component, and a refinement process of a metal component, and material recycle is presented with it as a glass caret and each metal. In this case, all the metals considered to be harmful are also collected and it processes according to the existing predetermined process. Moreover, the metal component separated from glass by the collected above-mentioned solid-state component 1 or the above-mentioned pickling can be supplied to the slurry tank (3) of this invention, and processing by supercritical fluid can also be further performed again on an elevated temperature and high-pressure conditions. In the temperature of this solid-state uptake tub (19), and a pressure, the solid-states of the liquid crystal it became impossible to dissolve in a supercritical solvent, or the decomposition product of a resinous principle are collected by the solid-state uptake tub (19) as a solid-state component 2. Moreover, as for a decomposition product respectively meltable to the solvent as the solid-state component 3, a solvent insoluble liquid component, and a very little gas component, a solid-state, a liquid, and gases are collected for the decomposition product it became impossible to dissolve in a supercritical solvent in the temperature of this separation tub (21), and the conditions of atmospheric pressure from a separation tub (21) as a solvent and solvent meltable liquid component. the above-mentioned solid-state component 2, the solid-state component 3, a solvent insoluble liquid component, and a solvent meltable liquid component — **** — being certain — it is and originates in resin — comparatively — the compound of the amount of macromolecules — it is — each — or the existing predetermined process dissociates and refines collectively, and material recycle is carried out as a raw material of a coal chemical product, it reuses as a fuel, namely, thermal recycling is presented. Moreover a gas component is processed in the existing waste gas down stream processing, it dissociates with a solvent meltable liquid component, and a supercritical solvent is processed by waste fluid down stream processing, or is recycled as a supercritical solvent of a system.

[0048] When it processes on the above-mentioned conditions , in order to process on that all the components of a liquid crystal panel are recoverable as a matter of fact since generating of a gas component is small , the point that the decomposition product of liquid crystal or resin is recoverable with high yield with material recycle or the gestalt which can carry out thermal recycling , and the conditions that temperature and a pressure are comparatively small , the operation cost of a system becomes effective [a small point] .

[0049] In addition, it sets to this invention and is a supercritical reactor (8). The setups of temperature and a pressure are not restricted to the above-mentioned conditions, and in order

to obtain the recovery object made into the purpose, they may set up and operate a proper temperature flow and pressure requirement. Moreover, supercritical reactor (8) Temperature and a pressure may be changed gradually or continuously and may be operated.

[0050] It is a direct supercritical reactor (8) about a liquid crystal panel below. The 2nd approach of teaching an inner supercritical reaction chamber (13) is shown. In this case, processed material tank shown in drawing 1 (1) Grinder (2) A slurry tank (3) and slurry tank impeller (4) Supercritical solvent tank (5) Tanks, such as a catalyst and drugs (6) And high-pressure slurry pump (7) It is not used but a high-pressure bulb (v4) is operated in the condition of having closed. Moreover, it is a supercritical reactor (8) in this case. If it carries out, it is drawing 3 (a), (b) (c) It is a supercritical reactor (8) so that it may be shown. What prepared the heating heater covering device (24) and supercritical reaction chamber covering device (25) which can be opened and closed to some heating heaters (14) and a part of supercritical reaction chamber (13) is used.

[0051] The liquid crystal panel which should be processed opens the above-mentioned heating heater covering device (24) and a supercritical reaction chamber covering device (25). It is this supercritical reactor (8) directly. It is a supercritical reactor (8) by it being taught to an inner supercritical reaction chamber (13), and shutting this heating heater covering device (24) and a supercritical reaction chamber covering device (25). And a supercritical reaction chamber (13) is sealed, respectively. In addition, it is drawing 3 (a) in this case. (b) (c) An electrode holder (26) is loaded with the liquid crystal panel (27) of two or more sheets, it is held, and you may make it teach a supercritical reaction chamber so that it may be shown. Moreover, a liquid crystal panel (27) is good to arrange along the flow direction of a fluid, and you may make it teach it to a multilayer, as shown in drawing 3 .

[0052] a supercritical solvent — tanks (9), such as a solvent, a catalyst, and drugs, from — it pressurizes to the pressure which forms a supercritical condition with a high-pressure liquid pump (10) — having — supercritical reactor (8) It is supplied. in this case, catalyst which is needed for processing with a request, drugs, such as an oxidizer, — a supercritical solvent — tanks (9), such as a solvent, a catalyst, and drugs, from — supercritical reactor (8) You may supply.

[0053] Supercritical reactor (8) It is made to be held to the temperature from which the inside of a supercritical reaction chamber (13) will be in a supercritical condition at a heating heater (14) by inside at heating and the pressure which temperature control is carried out and will be in a supercritical condition with a high-pressure pressure regulating valve (v1). In addition, the output of a heating heater is a supercritical reactor (8) by decomposition reaction heat, oxidation heat of reaction, etc. It is adjusted according to an inner temperature rise or the situation of a temperature fall.

[0054] A supercritical solvent is heated to the predetermined temperature which forms a supercritical condition by preheaters (12), such as a solvent, a catalyst, and drugs, and it becomes supercritical fluid, and goes into a supercritical reaction chamber (13), and processing is performed. That is, in the temperature in a supercritical reaction chamber (13), and a flow and pressure requirement, the matter which can dissolve dissolves in supercritical fluid among the metal components contained in TFT and the transparent electrode in a liquid crystal panel. Moreover, the low molecular weight compound which resinous principles, such as the liquid crystal and the polarizing plate in a liquid crystal panel, seal resin, and a spacer, happened, and the decomposition to a low molecular weight compound generated is dissolved in supercritical fluid. Components, such as a glass metallurgy group which the decomposition or the dissolution by supercritical fluid do not take place, or cannot dissolve, maintain a solid condition. In addition, in decomposition by the above-mentioned supercritical fluid, and the dissolution, in order to process in supercritical fluid, various kinds of harmful by-products containing dioxin are hardly generated.

[0055] If the processing phase of a liquid crystal panel is explained in full detail, in a supercritical reaction chamber (13), dissolution processing of the polarizing plate on the front face of a liquid crystal panel will be first disassembled and carried out by supercritical fluid. Disassembly of the seal resin which has pasted up the color filter base sheet glass and TFT base sheet glass of a

liquid crystal panel on coincidence, and the dissolution take place, base sheet glass exfoliates, the liquid crystal enclosed inside and the transparent electrode which exists in the medial surface, TFT, a color filter, etc. will be exposed to supercritical fluid, and dissolution processing will be disassembled and carried out. Moreover, glass is a supercritical reactor (8) as sheet glass in this case. It will remain inside and will be collected.

[0056] The fluid processed in the above-mentioned supercritical reaction chamber (13) is sent to a solid-state uptake room (15), and receives the same processing as the case of the approach mentioned above below to teach the 1st, and ****. Namely, as shown in drawing 1 R> 1, when supercritical reaction chamber churning ****** (17) etc. rakes out to a supercritical reaction chamber (13) and a device is installed in it, a product can also be raked out in the direction of an outlet of a supercritical reaction chamber (13) by driving this supercritical reaction chamber churning ****** (17). Moreover, supercritical reactor (8) It carries out and is drawing 2 (b). When what was shown is used, the component which only the above-mentioned solid-state sedimented in the solid-state uptake room (15), and dissolved in supercritical fluid and this supercritical fluid is sent by the condensator (18).

[0057] At a solid-state uptake room (15), separation of the supercritical fluid and the solid-state containing the component which dissolves in a decomposition product and supercritical fluid is performed, the supercritical fluid containing the above-mentioned decomposition product and a dissolution component is sent to a condensator (18), uptake of the solid-state is carried out and they are collected as a solid-state component 1 through the elevated-temperature high-pressure bulb for solid-state recovery (v2).

[0058] Supercritical reactor (8) It is cooled by the condensator (18) and the product which came out is sent to a solid-state uptake tub (19). Although a solid-state uptake tub temperature control jacket (20) adjusts the inside of this solid-state uptake tub (19) to predetermined temperature, it is made for the temperature of a product to become below the critical temperature of supercritical fluid in this case. When the temperature of supercritical fluid falls in this solid-state uptake tub (19), solubility becomes small, therefore uptake of the component which deposited as a solid-state is carried out as a solid-state component 2, and it is collected through the high-pressure bulb for solid-state recovery (v3). About the component which does not deposit within a solid-state uptake tub (19), it is conveyed from this solid-state uptake tub (19) with a supercritical solvent.

[0059] After the product which came out of the above-mentioned solid-state uptake tub (19) is decompressed to atmospheric pressure by the high-pressure pressure regulating valve (v1), it is sent to a separation tub (21). The inside of this separation tub (21) is adjusted to predetermined temperature by the temperature control jacket (22). A temperature [by which temperature control was carried out into this separation tub (21)], solid-state component [which deposited by becoming atmospheric pressure conditions] 3, solvent, and solvent meltable liquid component, a solvent insoluble liquid component, and a gas component carry out phase separation, and are collected, respectively.

[0060] After performing processing by predetermined time amount supercritical fluid, liquid sending of a solvent with a high-pressure liquid pump (10) etc. is stopped, and a pressure regulating valve (v1) is released, and it is a supercritical reactor (8). After returning inside to atmospheric pressure conditions, a heating heater covering device (24) and a supercritical reactor covering device (25) are opened, The solid-state components in a reactor are collected. Under the present circumstances, the above-mentioned liquid crystal panel is a direct supercritical reactor (8). Since it is taught inside, sheet glass is recoverable as it is. Moreover, when the liquid crystal panel of two or more sheets is prepared using an electrode holder (26), this electrode holder (26) and liquid crystal panels (27) can be collected collectively. By the existing predetermined approach, it dissociates, respectively and material recycle is presented with the obtained sheet glass.

[0061] In addition, it sets to this invention and is a supercritical reactor (8). It installs in two or more juxtaposition, Increase of deed throughput may be aimed at for processing to coincidence. moreover Supercritical reactor (8) More than one are prepared and processing by supercritical fluid is performed in a predetermined number of reactors. With the remaining reactors,

preparation is performed to the meantime. When the processing in the former reactor is completed, processing with the reactor which performed preparation is started, about the reactor which processing completed, actuation of performing ejection recovery of sheet glass and preparation may be repeated, and continuous processing may be performed.

[0062] The case where used water below and a liquid crystal panel is processed as a direct preparation and supercritical solvent below in a supercritical reaction chamber (13) is explained about the temperature in the above-mentioned supercritical reactor (8) for obtaining various kinds of target recovery objects for an example, and a flow and pressure requirement. First, supercritical reactor (8) The case where conditions are enough set as an elevated temperature and high-pressure conditions from the conditions, for example, critical temperature, that temperature and a pressure are comparatively high, and the critical pressure is shown. In this case, most metal components, such as metals, such as an indium contained in a transparent electrode or TFT, and an oxide of those, are dissolved in supercritical fluid. Moreover, resinous principles, such as resin in the polarizing plate in liquid crystal or a liquid crystal panel, seal resin, a spacer, and a transparent electrode, are also decomposed into very low-molecular compounds, such as a carbon dioxide, methane, ethane, ethylene, a methanol, ethanol, and ethylene glycol, and, for a ****** reason, color filter base sheet glass and TFT base sheet glass turn into transparent sheet glass into supercritical fluid. Some metal components which were not able to dissolve more completely than supercritical fluid maintain a solid condition.

[0063] In the above-mentioned conditions, from a supercritical reaction chamber (13), transparent sheet glass is collected and material recycle is presented. From a solid-state uptake room (15), some metal components which were not able to dissolve in supercritical fluid completely are collected as a solid-state component 1, and are processed according to the refinement process of the existing metal component, and material recycle is presented with them as each metal. In this case, all the metals considered that chromium, an arsenic, lead, etc. are harmful are also collected, and it processes according to the existing predetermined process. Moreover, the metal component separated from glass by the collected above-mentioned solid-state component 1 or the above-mentioned pickling can be supplied to the slurry tank (3) of this invention, and processing by supercritical fluid can also be further performed again on an elevated temperature and high-pressure conditions. The temperature of this solid-state uptake tub (19) and the solid-states of a metal component it became impossible to dissolve in a supercritical solvent by the flow and pressure requirement are collected by the solid-state uptake tub (19) as a solid-state component 2, all are processed according to the existing predetermined processes, such as a refinement process, also including the metal considered to be harmful, and material recycle is presented as each metal. Moreover, as for a low molecular weight compound respectively meltable to the solvent as the solid-state component 3, a solvent insoluble liquid component, and a gas component, the solid-state of a low molecular weight compound it became impossible to dissolve in a supercritical solvent in the temperature of this separation tub (21) and the conditions of atmospheric pressure from a separation tub (21), a liquid, and gases are collected as a solvent and solvent meltable liquid component. These compounds are very low-molecular compounds, and are processed according to the existing predetermined processes, such as waste gas down stream processing and waste fluid down stream processing. Moreover, it dissociates with a solvent meltable liquid component, and a supercritical solvent is processed by waste fluid down stream processing. Moreover, the above-mentioned supercritical solvent may be recycled as a supercritical solvent of a system.

[0064] When it processes on the above-mentioned conditions, in order to decompose that glass, the metal component which does not dissolve in supercritical fluid, the metal component which dissolves in supercritical fluid, a low molecular weight compound, etc. are separated, and it can collect, liquid crystal, and a resinous principle into the very low-molecular compound which does not contain harmful matter, such as dioxin, the point which does not need special waste gas down stream processing for processing harmful matter and a waste-water-treatment process becomes effective.

[0065] Next, supercritical reactor (8) The case where conditions are set to the conditions, for example, a subcritical state, that temperature and a pressure are comparatively low is shown. In

this case,.the resinous principle in liquid crystal or a liquid crystal panel serves as a decomposition product of a macromolecule comparatively, and is dissolved in supercritical fluid. Moreover, since the resinous principle in a transparent electrode decomposed and dissolved, the metal component in a liquid crystal panel maintains a solid condition in the condition of having exfoliated from TFT base sheet glass. Moreover, as sheet glass with transparent TFT base sheet glass, color filter base sheet glass turns into sheet glass with which the color filter was saved on the front face.

[0066] In the above-mentioned conditions, from a supercritical reaction chamber (13), the transparent sheet glass in a liquid crystal panel and sheet glass with a color filter are collected, and material recycle is presented, respectively. From a solid-state uptake room (15), only metal components are collected as a solid-state component 1, and are processed according to the existing predetermined processes, such as a refinement process of a metal component, and material recycle is presented with them. In this case, all the metals considered to be harmful are also collected and it processes according to the existing predetermined process. Moreover, the metal component separated from glass by the collected above-mentioned solid-state component 1 or the above-mentioned pickling can be supplied to the slurry tank (3) of this invention, and processing by supercritical fluid can also be further performed again on an elevated temperature and high-pressure conditions. In the temperature of this solid-state uptake tub (19), and a pressure, the solid-states of the decomposition product it became impossible to dissolve in a supercritical solvent are collected by the solid-state uptake tub (19) as a solid-state component 2. Moreover, as for a decomposition product respectively meltable to the solvent as the solid-state component 3, a solvent insoluble liquid component, and a very little gas component, a solid-state, a liquid, and gases are collected for the decomposition product it became impossible to dissolve in a supercritical solvent in the temperature of this separation tub (21), and the conditions of atmospheric pressure from a separation tub (21) as a solvent and solvent meltable liquid component. the above-mentioned solid-state component 2, the solid-state component 3, a solvent insoluble liquid component, and a solvent meltable liquid component — **** — being certain — it is and originates in resin — comparatively — the compound of the amount of macromolecules — it is — each — or the existing predetermined process dissociates and refines collectively, and material recycle is carried out as a raw material of a coal chemical product, or thermal recycling is presented as a fuel. Moreover a gas component is processed in the existing waste gas down stream processing, it dissociates with a solvent meltable liquid component, and a supercritical solvent is processed by waste fluid down stream processing. Moreover, the above-mentioned supercritical solvent is recycled as a supercritical solvent of a system.

[0067] When it processes on the above-mentioned conditions , in order to process on that all the components of a liquid crystal panel are recoverable as a matter of fact since generating of a gas component is small , the point that the decomposition product of liquid crystal or resin is recoverable with high yield with material recycle or the gestalt which can carry out thermal recycling , and the conditions that temperature and a pressure are comparatively small , the operation cost of a system becomes effective [a small point] .

[0068] In addition, it sets to this invention and is a supercritical reactor (8). The setups of temperature and a pressure are not restricted to the above-mentioned conditions, and in order to obtain the recovery object made into the purpose, they may set up and operate a proper temperature flow and pressure requirement. Moreover, supercritical reactor (8) Temperature and a pressure may be changed gradually or continuously and may be operated.

[0069]

[Example] The liquid crystal panel was processed by the 2nd approach mentioned above, i.e., the approach of teaching a liquid crystal panel to a direct supercritical reactor, using the supercritical reactor of drawing 3 (a) as an example of this invention. In the above-mentioned processing, using water as supercritical fluid, drugs, such as a catalyst and an oxidizer, were not added but processed by temperature 593K in a supercritical reactor, pressure 25MPa and temperature 693K, and pressure 35MPa. In addition, the TFT electrochromatic display panel for notebook computers was used for the liquid crystal panel to process.

[0070] In the processing performed by temperature 593K and pressure 25M Pa, sheet glass more transparent than after processing and the inside of a supercritical reaction chamber and the sheet glass with which the color filter remained were collected, respectively. Liquid crystal, the polarizing plate, the resin seal, the transparent electrode, etc. were not observed at all by the collected sheet glass front face. All over the solid-state uptake room, metal components which exfoliated or dissolved from the liquid crystal panel, such as an indium and titanium oxide, were observed, and, as for small quantity, the crystal of aromatic compounds, such as a biphenyl and methylphenyl benzene, was comparatively observed by the solid-state uptake tub. Moreover, when the fluid in a separation tub was analyzed, liquid crystal and resin, such as a methanol, ethanol, benzyl alcohol, an anisole, and a cyclohexanol, decomposed, the organic compound considered to have generated was observed and it was checked that it can process good. In addition, in this case, although there was very little generating of a gas component, little observation of a carbon dioxide and the methane was carried out.

[0071] In the processing performed by temperature 693K and pressure 35MPa, two transparent sheet glass was collected after processing and from the inside of a supercritical reaction chamber. Liquid crystal, the polarizing plate, the resin seal, the color filter, the transparent electrode, etc. were not observed at all by the collected sheet glass front face. Little observation of the titanium oxide was carried out at the solid-state uptake room, and metal components, such as an indium which dissolved from TFT etc., were observed from the solid-state uptake tub. Moreover, when the fluid in a separation tub was analyzed, the organic compound of the super-low molecule considered that liquid crystal and resin decomposed and generated wood ether, a methanol, ethanol, ethylene glycol, an acetaldehyde, etc. was observed, and it was checked that it can process good. In this case, a carbon dioxide, methane, ethane, hydrogen, etc. were obtained as a gas component.

[0072]

[Effect of the Invention] It is constituted as mentioned above, and a liquid crystal panel can be set in a supercritical reactor, it can decompose and dissolve by supercritical fluid, and this invention can collect the products completely, and can collect them as the metal component with which recycle can be presented, glass, a solvent meltable liquid component, a solvent insoluble liquid component, and a gas component. As compared with the case where the conventional art is used, this invention can perform efficient recycle processing, supercritical fluid is used for it, and since it decomposes and dissolves and processes a liquid crystal panel, it can collect useful components by high yield extremely, and can collect especially indiums. Moreover, in order to decompose in supercritical fluid and to reduce generating of harmful matter Do not need the special process for processing deleterious material, and processing is faced. Since neither the process of exfoliating a polarizing plate from color filter base sheet glass and TFT base sheet glass of a liquid crystal panel, nor the process of exfoliating color filter base sheet glass and TFT base sheet glass in two sheets is needed, processing can be easy and it can carry out economically.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The explanatory view showing one example of the recycle processing system of this invention.
[Drawing 2] The explanatory view showing other one example of the configuration of this invention.
[Drawing 3] The explanatory view showing other one example of the configuration of this invention.
[Drawing 4] The explanatory view of the structure of a liquid crystal display.
[Drawing 5] The explanatory view of the structure of a liquid crystal panel.
[Drawing 6] The explanatory view in the supercritical condition of explaining the supercritical fluid used by this invention.
[Drawing 7] The explanatory view of the dielectric constant of the supercritical fluid of water.
[Drawing 8] The explanatory view of the ionic product of the supercritical fluid of water.
[Description of Notations]
1 Processed Material Tank
2 Grinder
3 Slurry Tank
4 Slurry Tank Impeller
5 Supercritical Solvent Tank
6 Tanks, Such as Catalyst and Drugs
7 High-Pressure Slurry Pump
8 Supercritical Reactor
9 Tanks, Such as Solvent, Catalyst, and Drugs
10 High-Pressure Liquid Pump
11 Slurry Preheater
12 Preheaters, Such as Solvent, Catalyst, and Drugs
13 Supercritical Reaction Chamber
14 Heating Heater
15 Solid-state Uptake Room
16 Churning Shaft Sealing for Elevated-Temperature High Pressures
17 Supercritical Reaction Chamber Churning ******
18 Condensator
19 Solid-state Uptake Tub
20 Temperature Control Jacket
21 Separation Tub
22 Temperature Control Jacket
P1, P2, P3 Pressure gage
T1, T2, T3, T four Thermometer
v1 High-pressure pressure regulating valve
v2 The elevated-temperature high-pressure bulb for solid-state recovery
v3 The high-pressure bulb for solid-state recovery

v4, v5 High-pressure bulb
v6, v7 Bulb
L1 Solid-state component recovery Rhine
L2 Solvent and solvent meltable liquid component recovery Rhine
L3 Solvent insoluble liquid component recovery Rhine
L4 Gas component recovery Rhine
23 Batch Mesh
24 Heating Heater Covering Device
25 Supercritical Reaction Chamber Covering Device
26 Panel Electrode Holder
27 Liquid Crystal Panel

[Translation done.]